High-Tech Firms' Long-Term Export Behaviour –

The Experience of German and UK Companies

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Preface

Shortly after I started to work at the Centre for European Economic Research (ZEW) in Mannheim in November 1998, the head of my department, Georg Licht, introduced me to the topic of internationalisation of young technology-oriented firms. At that time, a joint research team comprised of Oliver Bürgel and Gordon Murray from London Business School and Andreas Fier and Georg Licht from the ZEW was investigating a unique data set of 600 newly founded technology-oriented firms in Germany and the UK that were surveyed in winter 1997/1998. Although I did not contribute to the analyses of the Anglo-German research team at that time, I had the opportunity of doing some econometric research of my own. Thereby, I became familiar with the questionnaires the conducted survey was based on, the resulting data set, and the theoretical and empirical literature related to individual firms' export activities.

Thus, it was almost self-evident that when Gordon Murray (now working at the University of Exeter) and Georg Licht planned to contact the original sample of 600 respondent firms a second time via a telephone survey in 2003, I became a member of the new research team which was completed by Marc Cowling from London Business School. I greatly enjoyed the work on this research project, in particular, because I had the opportunity to participate in each individual step of the project – starting with the development of the questionnaires, through supervising the German telephone survey conducted at the ZEW, preparing the data set, and finally carrying out the empirical analyses that constitute the key part of this thesis. Using data of both the first and the second survey, I examined the long-term export behaviour of the firms sampled. Such a longitudinal perspective has rarely been found in the related literature to date, leading to new interesting research questions, some of which are investigated in this thesis.

Of course, the completion of this thesis was only possible with the help and the support of numerous individuals and institutions. First of all, I gratefully acknowledge financial support from the HSBC Innovation and Technology Group and the Anglo-German Foundation for the Study of Industrial Society which financed the 2003 survey. Further, I thank the Centre for European Economic Research (ZEW) for providing me with the opportunity to write my thesis whilst working at the institute for the last two years.

Special thanks go to my supervisor Joachim Wagner. Since individual firms' export behaviour belongs to his main research interest, it was an optimal decision to contact him and he fortunately agreed to supervise my dissertation. However, Joachim Wagner did not only make useful suggestions in terms of the theoretical background, the econometric methods applied, and the interpreta-

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1 Introduction

Since the late 1970s, small and medium-sized enterprises (SMEs) have attracted growing attention from both policy makers and academics. In his pioneering study, Birch (1979) pointed out that about two-thirds of all new jobs created in the USA in the period from 1969 to 1976 can be attributed to the expansion of small firms with less than 20 employees. Birch's study led to an extensive debate on the contribution of SMEs to total employment and to the net creation of new jobs (see Storey [1994] for an overview). Although Birch's methodology was subsequently criticised and many scholars argued that he overestimated the extent of jobs created by SMEs (cf. Davis et al. 1996), it is today unquestioned that SMEs do in fact provide a large number of new jobs.[1]

Within the larger group of SMEs, the interest of economists and politicians is focused in particular on newly founded technology-based firms (NTBFs). Although NTBFs constitute the smallest players in high-tech sectors, the highest hopes with respect to employment creation are placed upon them – or at least have been in the past: During the late 1990s, exaggerated expectations and investors' hopes contributed to the high-tech bubble on stock markets that burst in 2000 (cf. Bank of England 2001). In today's post-bubble world, former expectations and hopes have been reduced. Nevertheless, the potential of NTBFs to create jobs is still a subject of intense discussion among policy makers and economists.

Although policy makers may primarily be interested in job creation, only those firms that possess a competitive advantage over their rivals are able to fulfil this expectation (Porter 1985). The ability of a high-tech start-up[2] to grow and provide new jobs thus depends essentially on its innovative capacity. NTBFs are therefore also expected to play an important role with respect to innovation, structural change, and regional development. NTBFs may contribute to the effective dissemination and commercialisation of knowledge, in particular of knowledge generated at universities and other public research institutions (e.g., institutes of the Max Planck Society in Germany). Scientists from universities or research institutes may decide to start an NTBF – a spin-off – to commercialise their scientific insights.[3] This is probably the most direct way of knowledge transfer from

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[1]   In their study on Germany, Boeri and Cramer (1991) revealed that in the period from 1977 to 1987 newly founded SMEs created 750,000 new jobs, whereas incumbent companies that already existed in 1977 increased the aggregated number of employees by only 350,000.

[2]   The terms "new technology-based firm" (NTBF) and "high-tech start-up" will be used interchangeably in this study.

[3]   Egeln et al. (2003b) provided a comprehensive study on public research spin-offs in Germany.

academia to industry. Moreover, entrepreneurs of NTBFs often cooperate with scientists from universities and research institutes (see Beise et al. 1995), transferring knowledge and technology into their production processes and incorporating it into their products and services. Finally, NTBFs themselves carry out substantial research and development (R&D) activities. Therefore, NTBFs are an important element of a country's innovation system.

All highly developed countries are currently evolving towards knowledge-intensive economies. Traditional industries like mining and quarrying or iron and steel manufacturing are stagnating or decreasing, reducing their number of employees and gross value added. Conversely, new industries like computer manufacturing, data processing, and biotechnology are arising. Moreover, in today's developed economies service sectors surpass manufacturing sectors with respect to employment, gross value added, and growth. NTBFs are a driving force of an economy's structural change. They are by definition founded in high-technology, presumably growing industries, thus increasing a country's stock of knowledge-intensive enterprises. They contribute to the transfer and commercialisation of research results (see above), create knowledge-based workplaces, and produce high-tech products and services. A country's structural change is, however, not restricted to knowledge-intensive industries. Companies operating in traditional industries like machinery or motor vehicle manufacturing may purchase NTBFs' products and services, integrating them as investment goods into their production processes or incorporating them as intermediate goods or business services into their own products. Thus, NTBFs aid incumbent firms in restructuring their production processes and improve the innovativeness of their products.

Policy makers' interest in the regional development role of NTBFs was in particular induced by the economic growth of concentrated areas of high-technology activity in the United States from the early 1970s. California's Silicon Valley and Route 128 around Boston, Massachusetts, are still the most prominent examples policy makers refer to when discussing regional technology clusters. Although there are no comparable European regions exhibiting such a concentration of incumbent and newly founded high-tech firms cooperating with each other in established networks, some European regions (e.g., Cambridge UK, Munich, Milan) were quite successful in attracting firm formations in high-technology industries. NTBFs may improve supply conditions and regional competitiveness as well as reducing the regional unemployment rate by creating new jobs[4]. Keeble (1989) and Murray (1998) found empirical evidence of the contribution of NTBFs to the development of fast-growing regions in Europe.

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[4]   Conversely, the market entry of high-tech start-ups may also endanger jobs since incumbent competitors may be crowded out (cf. Fritsch and Müller 2004).

In order to fulfil the expectations and hopes placed upon them, an international orientation is regarded as crucial for high-tech SMEs and, in particular, for NTBFs. The 2002 Observatory of European SMEs (European Commission 2002) highlighted that in 1998/1999, 65 % of all high-tech SMEs from ten European countries were operating internationally and receiving 19 % of their turnover from sales abroad. Since it is often argued that sales potential in European domestic markets is insufficient for the amortisation of high product research and development costs (see, e.g., McDougall et al. 1994, Bürgel et al. 2004), international business activities are expected to help European NTBFs amortise R&D costs, thereby enabling them to realise the expectations of policy makers and academics.

Entering the international market can be regarded as one of the greatest challenges faced by NTBFs. Firms are confronted with different market regulations and foreign social norms. Therefore, they have to collect information about the foreign business environment, which is an expensive and time-consuming task. Moreover, firms have to conduct a marketing campaign, set up foreign sales channels, and adapt their products and services to foreign regulatory requirements. Of course, these costs must be borne by all firms when entering a new target market – irrespective of their size and age. However, large firms can be assumed to possess more financial resources, enabling them to bear the additional costs of an international engagement. Furthermore, large companies may be able to place the responsibility of planning and organising foreign market entry on a qualified and experienced member of their workforces, whereas entrepreneurs of small, newly founded firms have to carry out all of the tasks related to an engagement in the foreign market themselves. Similarly, old firms that enter into the international market during a later stage of their life cycles are presumably established in their domestic markets. At the time they initiate their international business activities, they have probably already realised efficiency gains due to learning processes (Ericson and Pakes 1995, Jovanovic 1982). Conversely, newly founded firms do not yet know the value of their business ideas. Particularly in high-tech industries, launching a new product or service is connected with high uncertainty as to whether the new product will be accepted by the market. Thus, when entering the foreign market, a high-tech start-up is not yet established in its domestic market, does not yet fully exploit potential efficiency gains from learning processes and tends to export a product that has not yet proven its competitiveness. Nevertheless, it is now established knowledge that a relatively high percentage of NTBFs are internationally active shortly after their inception ("infant multinationals", Lindqvist 1991, "born globals", McKinsey 1993a).

How can NTBFs, the smallest players in the high-tech market, cope with the challenges of an international engagement? To what extent do NTBFs actually have international sales? What are

the differences between internationally active firms and those which only sell their products on the domestic market? Does exporting in fact improve the performance of NTBFs and help them fulfil the expectations placed upon them? These were the primary questions a joint research team comprised of analysts from the London Business School and the Centre for European Research (ZEW) intended to answer. To this end, the Anglo-German research team contacted a stratified random sample of German and UK-based NTBFs founded between 1987 and 1996 by sending out a written questionnaire in 1997/1998 (see Bürgel et al. 2004). It turned out that about two-thirds of the 600 responding firms had international sales at the time of the survey. Further, the sample's exporters generated 33 % of their total sales in the foreign market. These figures are very impressive, considering the barriers to foreign market entry discussed above. The 1997 study was also able to ascertain firm-specific characteristics that facilitate a firm's export activities: The probability of entering the foreign market increases with the firm's age and size, with R&D intensity (measured by a firm's expenditure on R&D as a percentage of total sales), and with firm managers' international experience. Conversely, an international engagement is impeded if the firm's product is highly customised. Finally, the Anglo-German research team found out that exporting did indeed improve the firms' labour productivity and increased their annualised sales growth rates between start-up and the time of the survey (i.e., 1997), but did not affect employment growth. This is an encouraging result for policy makers, although internationalisation did not have any impact on employment growth, that is, the number of new jobs created by NTBFs.

Of course, the internationalisation of firms has multiple dimensions (cf. Sullivan 1994b). In addition to their export activities, firms may import investment goods or components, i.e., internationalise on the procurement market. They may persuade foreign investors to invest in their company or they may themselves invest in foreign companies or build up a production subsidiary of their own abroad. Although imports of investment goods or components may be very important for small high-tech firms, it must be emphasised that the Anglo-German research team that conducted the survey in 1997 neglected these dimensions of a firm's internationalisation (cf. Bürgel et al. 2004). Thus, only firms that exported their products or services were regarded as internationally active firms, that is, only internationalisation on the sales market was considered.

One special feature of the survey conducted in 1997 and described in detail by Bürgel et al. (2004) was the comparison between German and UK NTBFs. There are two major reasons why such a comparison is helpful: Germany is often regarded as an example of a highly regulated economy, whereas the UK is usually referred to as a more deregulated economy. According to Hofsteede (1980, 1991) a regulated economy reflects a culture of strong uncertainty avoidance. Since the foreign market entry of an NTBF is always connected with high uncertainty, German NTBFs are,

ceteris paribus, expected to be less outwardly oriented than their UK-based counterparts. The second reason for an Anglo-German comparison is the fact that the directions of trade flows are significantly different between the two countries (see IMF 1994). Whereas for the UK trade with North America and the British Commonwealth plays an important role, German exports and imports are traditionally oriented towards neighbouring countries, France in particular. Furthermore, German trade with Eastern European countries increased significantly during the 1990s.[5] Therefore, Bürgel et al. posed the question of whether German and UK NTBFs differ from each other with respect to their probability of exporting and the geographical distribution of the firms' target markets. The main result of the 1997 survey regarding country-specific differences was that German and UK high-tech start-ups were very similar in their firm-specific characteristics, in particular with respect to their export behaviour. Nevertheless, the percentage of firms that had international sales in 1997 was indeed higher for the UK subsample, although the difference was smaller than might have been expected. Furthermore, the geographical scope of the sampled firms' target markets did indeed reflect the traditional directions of each country's trade flows: German NTBFs were more oriented towards Germany's neighbouring countries (including Eastern Europe), whereas North America and the British Commonwealth were more important for the export activities of UK-based high-tech start-ups.

The study by Bürgel et al. (2004) belongs to a series of studies that investigated the internationalisation processes of NTBFs during their start-up periods.[6] However, in order to create jobs and have a sustainable influence on (macro)economic development, continuous, long-term growth is needed and research must focus on the long-term development of NTBFs and the ongoing role of internationalisation. To the best of my knowledge, no study has been performed that observes NTBFs over a relatively long time period to investigate long-term internationalisation behaviour. Nevertheless, there are important questions regarding the international engagement of the firms in our sample: How many firms continued exporting after 1997, and how many terminated their international engagements? Did those firms that did not have international sales in 1997 enter into the foreign market, or did they remain confined to their respective domestic market? Were the exporters in our sample able to expand their export activities (e.g., increase their shares of total sales generated abroad)? Did the observed causal effects of exporting on firm performance remain valid as high-tech firms aged? In order to answer these important questions, a joint research team

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[5]   A third reason for a comparison between Germany and the UK is the debate on national innovation systems (Nelson 1992). The behaviour of NTBFs is definitely influenced by the domestic institutional context. However, an analysis of this relationship is beyond the scope of this study as well as the study of Bürgel et al. (2004).

[6]   Other examples are the studies of Lindqvist (1991) and McDougall et al. (1994).

from the ZEW and the University of Exeter conducted a second survey in summer 2003. All surviving firms from the original sample, which were then 12 years old on average (about 25 % of the firms had already dissolved), were contacted again. In order to ensure a high response rate, computer-aided telephone interviews (CATI) were used. A response rate of 55 % was obtained, and, after several consistency checks were performed, 217 companies were retained for the longitudinal analyses.

This study will examine empirically the long-term internationalisation behaviour of the firms in our sample of young technology-oriented companies from Germany and the UK. In accordance with the preceding study of Bürgel et al. (2004), I will restrict my analyses to the firms' export activities, that is, an internationalisation on the sales market.[7] In this context, the changing behaviour of the firms in the period between the two surveys will be of major interest. In order to interpret the export behaviour of the sampled firms, it is helpful to consider the macroeconomic conditions young high-tech firms were faced with from 1997 to 2003. Chapter 2 will therefore discuss firm dynamics (firm formations and closures) in high-tech sectors in Germany and the UK and the demand for high-tech products and services. The data set this study is based on will be described in detail in chapter 3. Thereafter, three dimensions of the firms' export activities will be analysed in chapter 4. In section 4.1, various theories of internationalisation will be reviewed in order to derive hypotheses that can be tested in the subsequent econometric analyses. The probabilities of foreign market entry and exit will be estimated in section 4.2. The related research literature is particularly thin on the ground when it comes to the identification of firm-specific variables that explain an exit from the foreign market. According to the theories discussed in section 4.1, a firm decides simultaneously on its foreign market participation *and* its optimal volume of exports. Thus, the firms' degrees of internationalisation (measured as the share of non-domestic revenues) will be examined in section 4.3. After entering the foreign market, one of the most important decisions firm managers have to make is the choice of the optimal sales mode. This choice depends on the firms' available resources and capabilities. However, these resources and capabilities change over time, compelling an exporter to adjust its foreign sales mode to these changing firm-specific conditions. The change of foreign sales modes will be examined in section 4.4. Chapter 5 will refer to the relationship between exporting and firm performance. It was already mentioned that, based on data from the 1997 survey, Bürgel et al. (2004) found that internationalisation improved the firms' labour productivity and enhanced their sales growth rates from the time of firm foundation to the time of the first survey. In order to test whether this causality remains valid

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[7] Throughout this study, the terms "internationalisation" and "exports" are therefore used interchangeably.

throughout later stages of the firms' life cycles, I will re-examine the export-performance relationship using data from the second survey. The results of this study will be summarised in chapter 6: The validity of the applied theories of internationalisation to explaining the firms' international business activities will first be discussed, followed by the differences in the firms' internationalisation behaviour over time. Similarities and differences between German and UK-based high-tech firms will be elaborated before I will discuss the managerial and policy implications derived from this study.

2 Development of High-Tech Industries

In order to interpret the export behaviour and performance of our sample of technology-based firms from Germany and the UK, it is useful to consider the macroeconomic conditions young high-tech firms are faced with. Since the changing behaviour of our sample's firms in the period between 1997 and 2003 will be of major interest in this study, the following chapter will concentrate on macroeconomic development during the last decade. After presenting a definition of high-tech industries, firm dynamics in high-tech sectors will be discussed. A high number of firm foundations can be regarded as an indicator of market growth. On the other hand, numerous newly founded firms show that incumbent firms are constantly challenged by new rivals. As a result of intense competition, some firms are forced to exit the market. Thus, the number of firm closures is the second indicator of firm dynamics that will be investigated.

The development of a firm is, of course, influenced by different factors. In this chapter, I will restrict myself to examining the development of the demand for high-tech products and services in Germany and the UK in order to evaluate high-tech firms' sales prospects in the two countries. Finally, the impact this chapter's findings have on analysis of high-tech firms will be presented in the last section.

2.1 Definition of High-Tech Industries

In this study, technology-oriented firms are identified using the definition of high-technology industries in the UK established by Butchart (1987). He provided a definition based on two criteria: firstly, the ratio of R&D expenditures to total sales (R&D intensity)[8] and secondly, the share of scientists, professional engineers, and technicians in the total number of employees. The primary measure for identifying a high-tech industry is its R&D intensity. A manufacturing industry will automatically be included in the list of high-tech sectors if its R&D intensity lies "substantially above" the manufacturing average. In order to determine a value that is "substantially above" the average of all manufacturing industries, Butchart took a threshold value of 20 %, i.e., all industries whose respective R&D intensities amount to at least 120 % of the manufacturing average automatically qualify for inclusion in the list of high-tech sectors. Those industries that reveal an R&D

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[8]   Butchart (1987) also discussed whether gross value added should be preferred to total sales in measuring R&D intensity. Butchart argued in favour of total sales because firstly, data on firms' total sales are more often available than data on gross value added and secondly, total sales are less influenced by a firm's decision to outsource parts of its production process.

intensity higher than the manufacturing average but lower than the chosen threshold value become "candidates" for inclusion. Whether these doubtful cases will ultimately be defined as high-tech industries depends on the second criterion, i.e., the share of scientists, professional engineers, and technicians in the labour force. High-tech candidates qualify for inclusion in Butchart's list if this second measure is substantially above the manufacturing average, i.e., achieves a value of at least 120 % of the average share of all manufacturing industries. It is also important to note that almost all of the industries that automatically enter Butchart's list of high-tech industries because of their substantially above-average R&D intensity have a substantially above-average proportion of scientists and professional engineers in their respective workforces. Thus, the second criterion is only necessary to resolve doubtful cases as described above. In this way, Butchart identified sixteen UK 1987 SIC codes from the manufacturing sector, which were translated into the NACE Rev. 1 code and are listed in detail in Table 2-1.

Taking the manufacturing industries identified by Butchart, Bürgel et al. (2004) defined four aggregated manufacturing sectors: information and communication technology (ICT-)hardware, engineering industries, health and life sciences, and a sector consisting of miscellaneous high-technology manufacturing industries, labelled "other high-tech manufacturing". In the following, the descriptive statistics and the definition of several dummy variables used in this study's econometric analyses are based on these aggregated sectors.

Table 2-1: Definition of High-Tech Sectors

Aggregated industries used	NACE Rev. 1	Short description according to NACE Rev.1
R&D-Intensive Service Industries	64.20; 72.20; 72.30; 72.40; 72.60; 73.10	Telecommunication, Computer Programming and Software Services, Data Processing, Misc. Computer Services, R&D in Natural Sciences and Engineering
ICT-Hardware	30.01; 30.02; 32.20; 32.30	Office Equipment; Computers and Other Information Processing Equipment; Television and Radio Transmitters and Apparatus for Line Telephony and Line Telegraphy; Television and Radio Receivers, Sound or Video Recording and Reproducing Apparatus
Engineering Industries	33.20; 33.30; 33.40	Electronic Instruments and Appliances for Measuring, Checking (except Industrial Process Control); Electronic Industrial Process Control Equipment; Optical Instruments; Photographic Equipment
Health and Life Sciences	24.41; 24.42; 33.10	Pharmaceutical Products and Preparations; Medical and Surgical Equipment and Orthopaedic Appliances
Other High-tech Manufacturing	24.16; 24.17; 31.10; 31.20; 32.10; 35.30	Plastics and Synthetic Rubber in Primary Form; Electric Motors, Generators and Transformers; Electricity Distribution and Control Apparatus; Electronic Valves, Tubes and other Components; Aircraft and Spacecraft Manufacturing

Source: Manufacturing sector: Butchart (1987); service sector: Bürgel et al. (2004).

Bürgel et al. (2004) augmented the four aggregated manufacturing sectors by adding a fifth sector containing R&D-intensive service industries (see Table 2-1). Butchart (1987) himself emphasised the necessity of considering service-sector industries when defining the high-technology sector. However, due to data restrictions, Butchart was somewhat arbitrary in choosing three service-sector industries to add to his list of high-tech industries: telecommunications, computing services, and research and development institutions. Of course, R&D institutions seem to be predestined for inclusion in any list of high-tech industries that is based on firms' R&D intensities. Additionally, more recent studies, e.g., by Harhoff et al. (1996), Licht et al. (1997), and Nerlinger (1998), revealed that, at least in Germany, service firms in some industries carry out extensive R&D and innovation activities. These results confirm that the service sector industries selected by Butchart do indeed fall into the category of R&D-intensive industries. Thus, the aggregated service sector established by Bürgel et al. (2004) both corresponds to Butchart's arbitrary choice and is justified by recent empirical results.[9]

Butchart's list of high-technology industries is a rather short one. An alternative definition that is frequently applied when examining the German high-technology manufacturing sector was derived by Grupp and Legler (2000). In addition to those manufacturing industries already included in Butchart's list, Grupp and Legler in particular allowed for several classes of the industries "manufacturing of machinery and equipment" (NACE code 29.00) and "manufacturing of motor vehicles" (NACE code 34.00). Considering further that these two industries amount to just under one-third of total turnover in the German manufacturing sector in 2003 and to 44 % of the German manufacturing sector's expenditures on in-house R&D in 2001 (cf. Stifterverband 2004), neglecting these two industries constitutes a severe shortcoming when examining newly founded technology-based firms in Germany.[10] Nevertheless, all of the industries on Butchart's list are also included in Grupp and Legler's definition. This is particularly encouraging to note because Butchart's definition is based on data from the beginning of the 1980s and, as the rate of technological change accelerates, definitions of high-technology industries are subject to frequent revisions. Thus, this study analyses manufacturing (and service) industries that have belonged to the high-technology sector over the last two decades.

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9   The studies cited above further identified two other R&D-intensive service industries that were not considered by Bürgel et al. (2004): architectural and engineering activities and related technical consultancy (NACE code 74.20) and technical testing and analysis (NACE code 74.30).

10   In the UK, the two indicated manufacturing industries generated only 18 % of the manufacturing sector's total turnover in 2003. The sources of the turnover data will be described in section 2.3 and appendix A.1.

2.2 Firm Dynamics in Aggregated High-Tech Sectors

Newly founded firms play an important role in the development of technology-oriented markets. They introduce and commercialise new products, services, and production processes, thus stimulating and intensifying competition on their high-tech markets. New firms occupy market niches that (large) incumbent companies do not recognise or are not interested in, e.g., because they regard the innovative idea in question as unprofitable, or because of a lack of flexibility to adjust their production processes to the requirements of the new product or service. Thus, the development of the number of firm foundations is an important indicator in characterising the dynamics on high-technology markets. The introduction of innovative products and services is, however, connected with high uncertainty. In the long run, only a fraction of all newly founded firms can establish itself in the market. On the other hand, if a firm's innovative product achieves acceptance by the customer, the firm will be able to realise high growth rates and put its rivals out of the market. Firm closures are therefore the opposite of firm formations.

In this section, firm formations and closures as the two main indicators of high-tech markets' firm dynamics will be discussed in detail. The related literature normally regards firm growth as a third indicator of firm dynamics (see, e.g., Klepper 1996). However, it is difficult to acquire data on growing and shrinking firms on an aggregate level. Therefore, firm growth will be neglected in this section.[11] After a description of the German and the UK databases that are used for the analysis, the development of the number of firm formations in the five high-tech sectors will be examined for both Germany and the UK. Since the absolute numbers of firm formations are not comparable between the two countries, I will focus on *changes* in the number of start-ups with respect to the base year 1995. In a second step, the sectoral structure of all technology-oriented firm formations (as defined by Butchart 1987) will briefly be described, highlighting the numerical importance of newly founded firms from the software and service sector. Thereafter, the development of firm closures will be analysed analogously to the number of start-ups. Firm formations and closures determine the net gain or loss in a sector's stock of enterprises, contributing to an economy's structural change. Unfortunately, the German data do not allow calculation of changes in the stock of enterprises (see the explanations of the data bases below). Thus, we have to restrict ourselves on UK data when examining changes in the stock of enterprises during the last decade.

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[11] Instead, chapter 5 will examine growth processes of the firms in this study's sample in detail.

Box 2-1: The ZEW Foundation Panel

Since 1989 the ZEW has been working in cooperation with Creditreform in setting up several panel data sets regarding firms in Western and Eastern Germany. As Germany's largest credit rating agency, Creditreform has the most comprehensive database of German firms at its disposal and provides its data on German firms to the ZEW for research purposes.

The statistical unit of the Creditreform database is the legally independent firm. Information from various public registers (in particular the trade register) as well as from daily newspapers and company reports are regularly collected. The information available in the Creditreform database includes firm names, addresses, industry classifications, and foundation dates. In most cases, Creditreform records the entire history of each firm. It is thus generally possible to distinguish original start-ups from transfers of already existing firms to new owners and other derivative foundation events like (de-)mergers or changes of legal form (for methods of identifying an original foundation when a complete firm history is not available, see Almus et al. 2000a).

Since new firms in the trade register are checked on a regular basis by Creditreform, almost all firm foundations recorded in the trade register are contained in the Creditreform database. The probability of an unregistered firm entering Creditreform's database depends on the scope of its credit demands and the extent of its business activities. Hence, coverage of micro firms remains incomplete. Moreover, newly founded unregistered firms in particular enter the Creditreform database with a significant delay. Based on estimates of the percentage of firms that are recorded by Creditreform after a certain time lag, the number of firm foundations in recent cohorts is predicted. This guarantees accurate comparisons over time.

Firm liquidations, defined as the final termination of a firm's entire business activities and the selling off of its assets, are also recorded by Creditreform. However, reliable information on firm closures only exist in the case of an insolvency (i.e., a forced liquidation due to an incessant inability to pay or over-indebtedness) since these data are easily available due to compulsory publication in official registers. Voluntary firm closures (e.g., a firm whose owner is still able to settle all of its financial obligations but has decided to exit from the market because the firm's financial situation has deteriorated) often enter the database long after their realisations; accurately predicting the number of such closures is therefore impossible. Thus, in this study we have to restrict ourselves to the number of insolvencies when describing the development of firm closures below.

Source: Almus et al. (2000a, 2000b), Engel and Fryges (2002).

An international comparison of the development of firm formations and closures is rather difficult since no standardised data sources currently exist. In particular, the numbers of start-ups and closures can hardly be compared between different countries because the statistical units that are examined by the various databases are often not identical (e.g., plants versus legally independent companies). However, in this section we are primarily interested in the *development* of the number

Box 2-2: VAT Registrations and De-Registrations in the UK

The Small Business Service Statistics Team annually publishes the number of VAT (value added tax) registrations and de-registrations in the UK. The data are taken from the Office for National Statistics' Inter-Departmental Business Register (IDBR). All companies registered for VAT and all businesses operating a Pay As You Earn (PAYE) scheme are recorded in the database. Very small businesses are not covered by the IDBR. The threshold for compulsory VAT registration at the beginning of 2003 was an annual turnover of £ 56,000. Below that value businesses can register voluntarily. Thus, like in the Creditreform database for Germany, micro firms are not entirely covered.

One advantage of the database is the fact that VAT registrations and de-registrations are indicators of firm foundations and closures which are comparable to one another – i.e., VAT de-registrations do not only include insolvencies but also voluntary firm closures. This allows calculation of the annual net gain or loss in the stock of registered enterprises in the UK. It should be noted that, in a minority of cases, VAT de-registrations occur because a firm's turnover has fallen below the registration threshold. However, this does not affect the validity of VAT de-registrations as an approximation of the number of firm closures.

Registrations and de-registrations are sometimes recorded in the IDBR database with a moderate time lag. In order to guarantee an accurate comparison over time, the Small Business Service Statistics Team adjusts the latest data from IDBR to produce the best estimates of the number of firm foundations and closures in most recent cohorts.

The data are available online at http://www.sbs.gov.uk/content/analytical/statistics. Unfortunately, it is only possible to compile time series for the cohorts from 1994 to 2003. Older data on registrations and de-registrations do exist, but they are not disaggregated to the level of the three-digit UK 2003 SIC code (a classification equivalent to the NACE code), which is necessary to determine the number of firm foundations and closures in the high-tech industries identified by Butchart (1987).

Source: Small Business Service (2004a, 2004b).

of firm formations and closures in Germany and the UK and not in the number itself. For this purpose, it is sufficient that the data are consistent over time. Moreover, the data should allow a country-specific comparison of different sectors, in particular between those defined in the previous section. In order to describe firm dynamics in German high-tech sectors, the ZEW Foundation Panel is used. Since this panel also provides the basis for drawing the random sample the two surveys of this study are based on (see chapter 3), it is illustrated in greater detail in Box 2-1. The UK data on firm dynamics originate from the Small Business Service based on VAT (value added tax) registrations and de-registrations. They are described in Box 2-2.

Figure 2-1 shows the development of firm foundations in the selected high-tech sectors in Germany and the UK. As the description of the data sources revealed, the absolute number of firm

foundations is not comparable between the two countries. Moreover, the number of firms that were founded in the five high-tech sectors considered also differs significantly.[12] Therefore, Figure 2-1 displays index series which are normalised such that the sector-specific number of start-ups in 1995 is set to the index value 100. The index series cover the entire available time span, i.e., the development of firm foundations in Germany is described from 1990 to 2003, whereas in the UK we are restricted to the period from 1994 to 2003 (cf. Box 2-2).

The development of high-tech start-ups is analysed separately for the Western and the Eastern states of Germany. This is particularly important during the first six years after German reunification (i.e., from 1990 to 1995) when an entirely new stock of independent, privately owned firms had to be built up in Eastern Germany. As a consequence, in this period the number of firm formations was high, but decreasing. This development is reflected by the index series in Figure 2-1. Thus, the indices for Eastern Germany (including former West Berlin) should not be compared with those of Western Germany and the UK before 1995.

Examining the course of the index series in Figure 2-1, the most outstanding result is the tremendous increase in the number of start-ups in the software and service sector in both Germany and the UK. In Western Germany, the number of newly founded software and service firms rose over one decade, reaching a (global) maximum in 2000, when the number of firm foundations was 60 % higher than in 1995. Similarly, in Eastern Germany the quantity of service start-ups in 2000 exceeded the 1995 figure by 79 %. The highest number of newly registered service firms in the UK was already observed in 1998, attaining an index value of 174. In the subsequent year, the number of firm foundations decreased, but ascended again to a second local maximum in 2000. The dynamic of the service sector in the nineties of the last century clearly mirrors the emergence of new business opportunities due to an increased diffusion of information and communication technologies.

However, there was a downturn in the number of start-ups in the software and service sector after 2000 in both countries. The turning point of the UK index series dates back to as early as 1998, whereas the decline of the number of newly founded service firms was only interrupted by a slight rise in 2000. In Eastern Germany and the UK, the downturn continued until 2003, although at a decreasing rate. Nevertheless, the number of newly registered service firms in the UK was smaller in 2003 than in 1995. In contrast, the level of firm foundations in Western Germany rose again by 4.6 % from 2002 to 2003. It remains to be seen whether this development is the first sign of a new

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[12] The sectoral structure of all firm foundations in the high-technology sector as defined by Butchart (1987) is discussed below.

Figure 2-1: Firm Foundations in Aggregated High-Tech Sectors
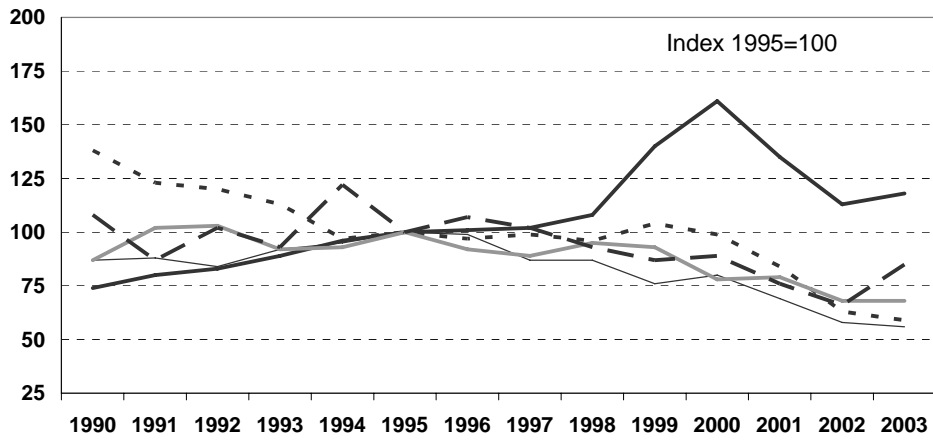
West Germany

East Germany
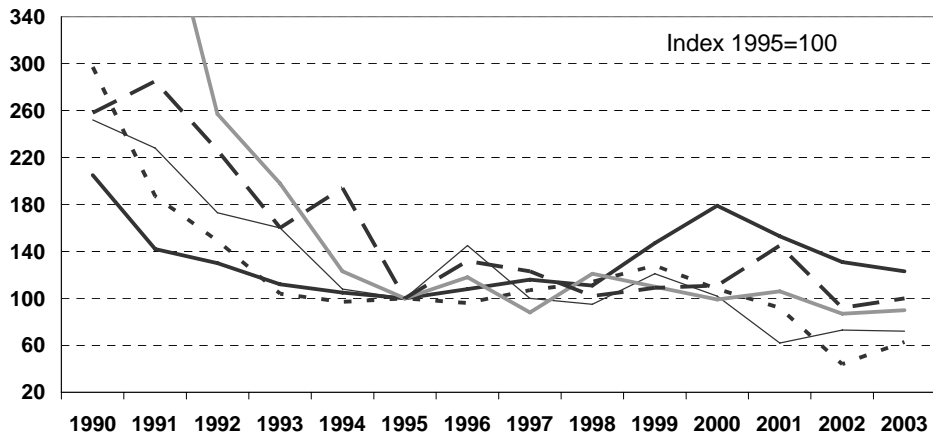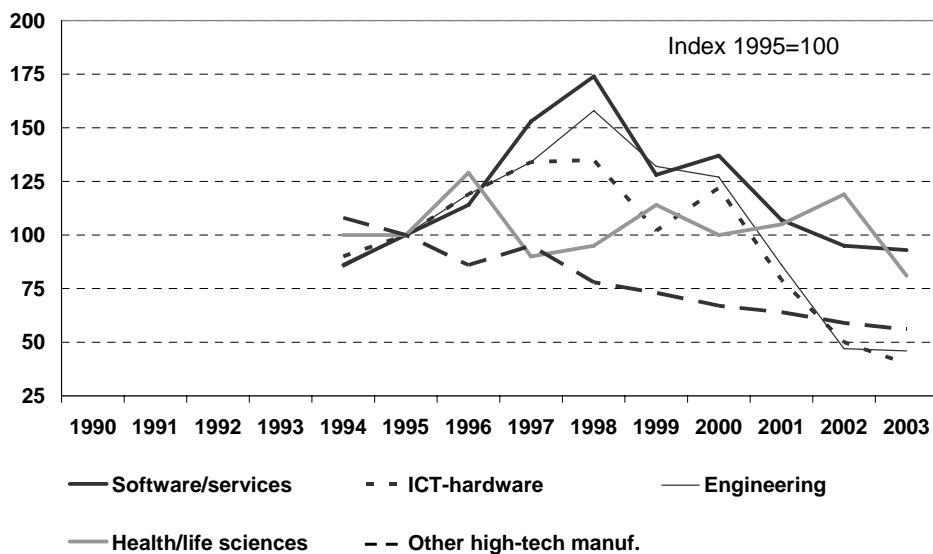
UK

| Software/services | ICT-hardware | Engineering |
| Health/life sciences | Other high-tech manuf. | |

The UK sector "other high-tech manufacturing" includes the complete NACE group 24.1.
Source: ZEW Foundation Panel, Small Business Service Statistics Team, own calculations.

boom in the number of start-ups in the service sector or whether the observed increase is only a transitory event.[13]

As regards the four aggregated manufacturing sectors, the number of firm formations declined in the most recent years in nearly all analysed manufacturing sectors. In 2003, no single index series attained a value higher than 100, i.e., in all manufacturing sectors the number of start-ups in 2003 was smaller than in 1995. However, the courses of the index series differ between Germany and the UK. In Western Germany, the two sectors health/life sciences and other high-tech manufacturing industries revealed a relatively constant level of newly founded firms during the nineties, although in some years the number of start-ups exceeded or fell below the 1990s mean. In 2002, however, the number of firm foundations amounted to only two-thirds of the respective quantity in 1995. In the sector of other manufacturing firms the level of firm formations increased again from 2002 to 2003, but the index remained below its average value from the previous decade. Thus, similarly to the software and service sector, there was a downturn in the number of newly founded firms after 2000 in these two sectors. The level of start-ups of new engineering firms in Western Germany rose from 1990 to 1995, reaching its maximum during the time period examined. Afterwards, however, it declined continuously until 2003, attaining a level just over half of its maximum. Finally, the number of firm formations in the Western German ICT-hardware sector decreased from 1990 to 1994, remained constant until 2000 and, in accordance with the development in the other manufacturing sectors, declined again thereafter. At first glance, this finding is somewhat surprising: Arguing that the tremendous rise in newly founded software and service firms in the nineties was a result of the increased diffusion of information and communication technologies, one should expect numerous business opportunities for start-ups that intend to manufacture hardware components. Obviously, the rising demand for ICT hardware in (Western) Germany was only to a small extent accommodated by newly founded firms. Instead, a combination of growing sales in incumbent German firms, the establishment of subsidiaries of foreign multinational companies in Germany, and imports probably met the increased demand for hardware components.[14] [15]

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[13] In 2003, the number of firm formations in Germany was significantly influenced by a newly introduced government aid that intends to encourage formerly unemployed persons to set-up a new business (catchword: "Ich-AG"). Unfortunately, the Creditreform database does not allow us to determine which firms were founded by a formerly unemployed entrepreneur, and, therefore, the extent to which the observed increase in the number of start-ups in the service sector results from this new government aid. However, it can be argued that unemployed persons are more likely to start a new business in sectors with low barriers to entry, e.g., low (sunk) investment costs. Thus, it is more likely to find an entrepreneur supported by this new measure in the service sector than in the manufacturing sector.

[14] Recall that the statistical unit of the Creditreform database is the legally independent firm. Thus, the formation of a new plant by a German or a foreign company is not recorded in the database.

The development of Eastern German high-tech manufacturing sectors is more encouraging than that of the respective Western German sectors. The index series in Figure 2-1 indicate that the number of firm foundations in each manufacturing sector increased in the period from 1995 to 2001, reaching a maximum that was significantly higher than the level of start-ups in the reference year 1995. For example, in 1999 the number of newly founded ICT-hardware firms in Eastern Germany was 28 % higher compared with the respective number in 1995. In the sector of other high-tech manufacturing industries, the level of firm foundations in 2001 exceeded that of 1995 by 45 %. However, the number of start-ups in more recent cohorts declined again and, with the exception of other high-tech manufacturing industries, fell significantly below the 1995 level.

In order to assess the foundation activities in the Eastern German high-tech manufacturing sectors, it should first be noted that the absolute number of high-tech firm foundations in Eastern Germany recorded by Creditreform is very small. For example, in 1995 only 53 firms were set up in the sector of other high-tech manufacturing industries. The most firm foundations were observed in the sector of health/life sciences, where 103 start-ups were recorded in 1995. Thus, even a sharp increase in the Eastern German index series only reflects one or two dozen additional firm foundations. Moreover, although the development of firm formations in Eastern German manufacturing sectors was more positive than in the western part of Germany, the foundation intensities, defined as number of start-ups per one million inhabitants aged between 18 and 65, were generally smaller in Eastern Germany. For example, whereas in Western Germany the foundation intensity of the ICT-hardware sector was 9.9 in 1995, there were only 6.1 newly founded ICT-hardware firms per one million inhabitants aged between 18 and 65 in Eastern Germany. Similarly, the Western German foundation intensity of the sector of heath/life sciences was 14.6 in 1995; in Eastern Germany the respective value amounted to only 8.9. Since, in contrast to West Germany, the number of newly founded manufacturing firms in Eastern Germany increased after 1995, the Eastern German foundation intensities approached to the respective West German values. In the engineering sector and the sector of other high-tech manufacturing, the Eastern German foundation intensities even exceeded those of Western Germany when the number of firm foundations reached their maximum. However, due to the decline in the number of start-ups in most recent years, the foundation intensities of Eastern German manufacturing sectors again fell below the

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[15] These arguments are supported by the development of German plants' turnover as depicted in Figure 2-3: Sales of plants operating in the ICT-hardware sector and located in Germany doubled from 1995 to 2000. The plants were able to generate higher sales on the German as well as the foreign market (see the discussion below). Taking into account that the number of start-ups remained constant during this period, the increasing demand in Germany was at least partly met by growing incumbent plants.

reference values of the West German sectors.[16] Considering the important role of newly founded high-tech firms with respect to technology transfer and the creation of new, internationally competitive jobs, the relatively small foundation intensities of high-technology sectors in East Germany may constitute an obstacle to realising macroeconomic growth (see Engel and Fryges 2005).

In the UK, the number of newly registered manufacturing firms in the ICT-hardware and engineering sectors rose significantly from 1994 to 1998. In the latter sector, the level of firm foundations then decreased continuously until 2003, when it attained an index value of 46, i.e., in 2003 the number of newly founded engineering firms was less than half of the respective quantity in 1995 and less than one-third of its maximum level in 1998. Likewise, firm formations in the ICT-hardware sector declined after 1998, although, analogous to the UK software and service sector, the index series has another local maximum in 2000. Nevertheless, the number of newly founded ICT-hardware firms in the UK reduced by two-thirds within the following three years. The decrease was less dramatic in the sector of other manufacturing firms. With the exception of 1997, the number of start-ups in this sector fell steadily from 1994 to 2003, whereas in the last observed year the number of firm foundations amounted to just over half of the respective value in 1994. The development of firm formations in the smallest UK manufacturing sector, namely the sector of health/life sciences, is characterised by considerable fluctuations around the reference index value 100.[17] In 2003, the number of start-ups decreased by one-third in comparison to the previous year.

Table 2-2: Sectoral Structure of High-Tech Firm Foundations in 1996 (in %)

	West Germany	East Germany	UK
Software/services	77.87	70.11	92.60
ICT-hardware	5.13	5.28	2.97
Engineering	5.81	9.70	2.04
Health/life sciences	7.21	9.47	0.79
Other high-tech manuf.	3.98	5.43	1.60
Total	100	100	100

The UK sector "other high-tech manufacturing" includes the complete NACE group 241.

Source: ZEW Foundation Panel, Small Business Service Statistics Team, own calculations.

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[16] The difference is even more distinct in the software and service sector: Whereas the Western German foundation intensity in this sector amounted to 144.6 in 1995, the respective Eastern German value was only 72.2. Since the development of newly founded software and service firms was similar in both parts of Germany after 1995, the difference remained relatively unchanged (foundation intensities in 2000: West Germany: 232.8; East Germany: 130.6).

[17] The Small Business Service Statistics Team recorded 105 newly registered enterprises in the sector health/life sciences in 1995.

However, it is not yet possible to determine whether this reduction corresponds to the downturn in foundation activities the other manufacturing sectors have experienced in most recent years, or whether this is just a transitory reduction and the index series will turn upward again.

As already mentioned, the index series do not provide any information about the level of firm foundations in the examined sectors. Moreover, the absolute numbers of start-ups are not comparable between the two countries. However, the databases allow an analysis of the sectoral structure of each country's high-tech firm formations. Table 2-2 shows the sectoral distribution of the high-tech start-ups in Germany and the UK. I chose the year 1996 as an example for the analysis in Table 2-2. This is the last cohort that was selected for drawing the random sample this study's empirical analysis is based on (see chapter 3). Of course, since the development of the number of newly founded firms differed between the observed sectors in subsequent years, the share of a particular sector in all high-tech firm formations changed accordingly, especially in favour of the software and service sector. Nevertheless, the main results remain unaltered.

In both countries, most new firms were founded in the software and service sector. Setting up a new business in the service sector generally requires less (financial) resources then establishing a new manufacturing firm. This implies lower barriers to entry for service firms, leading to a higher fluctuation in the stock of enterprises operating in the market. Interestingly, the percentage of new software and service firms in the UK is considerably higher than in Germany. Thus, the foundation activities in the UK high-tech sector are far more dominated by service providers than in Germany. On the other hand, the share of firm formations in the sector of health/life sciences in Germany exceeds the respective UK value significantly. This higher percentage is mainly attributed to a large number of newly founded firms manufacturing medical and surgical equipment. Whereas in Germany the number of firm foundations in this group is more than five times larger than the number of start-ups in the sector's second group, i.e. manufacture of pharmaceuticals, the quantity of firm formations in these two groups is on the same level in the UK.

It is rather difficult to explain the varying development of the number of firm foundations in the two countries and the five examined high-tech sectors. The individual decision to set up a new enterprise is influenced by numerous factors affecting the individual's decision-making process from the supply side as well as from the demand side (for an overview, see Steil [1999] or Egeln et al. [2003a]). For example, in the course of the increased diffusion of information and communication technologies, the German economy experienced a lack of qualified ICT personnel, leading to higher wages for the firms' ICT workforce. Thus, it cannot be excluded a priori that the decreasing number of firm formations in the Western German ICT-hardware sector results from this

supply side restriction: Higher wages in the incumbent ICT companies increase the individual's opportunity costs of self-employment, reducing the probability of setting up a new business.[18] On the other hand, the growing diffusion of information and communication technologies improves the sales prospects of a newly founded firm, raising the individual's inclination to start a business. It is possible that this demand-side effect was dominant in the UK, resulting in a rising number of start-ups in the country before 1998. Without a profound econometric analysis it is not possible to determine which factors have a causal impact on the observed number of firm foundations. Such an analysis is, however, beyond the scope of this study. Instead, in the following section I will focus on a possible demand-side effect by investigating the development of sales as a measure for the demand for the firms' (high-tech) products and services.

First, however, the development of firm closures as the second indicator of high-tech markets' firm dynamics has to be discussed. Data on firm closures are even more difficult to obtain than data on firm foundations. For the UK, the Small Business Service Statistics Team annually publishes the number of businesses de-registering from VAT, which is an appropriate estimate of the number of firm closures and is directly comparable with the number of newly registered firms that was used as a measure of firm formations. The development of firm closures in Germany is approximated by the number of insolvencies. This approximation has two shortcomings. Firstly, the large number of voluntary firm closures is neglected. Unfortunately, this number cannot be predicted using the Creditreform database, which restricts the following analysis to forced firm liquidations, i.e., insolvencies (see Box 2-1). According to Prantl (2002) insolvencies account for only 20 % of all liquidations of young firms (six years old and younger at the time of firm closure) in Western Germany. In high-technology industries (as defined by Grupp and Legler [2000] and Nerlinger [1998]; see section 2.1), at least, the share of insolvencies amounts to 44 % of all closures of young firms in Western Germany (see Egeln et al. 2003a). Secondly, due to amendments made to the German Insolvency Statute[19] in 1999 and 2001 an insolvency does not necessarily induce a firm's liquidation, that is, an exit from the market. Instead, the Insolvency Statute allows a continuation of a firm's businesses by the insolvency administrator or the debtor himself. This may lead to a reorganisation of the firm, although it can be expected that in most cases the insol-

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[18] The lack of qualified ICT personnel in Germany before the year 2000 was analysed, e.g., by Licht et al. (2002). 64 % of all German firms in the ICT sector (according to the definition of OECD [2000] which includes ICT-hardware as well as software, ICT-services, and wholesale trade of ICT products) offered candidates higher wages in response to a lag of ICT personnel they were experiencing. In 72 % of the firms the existing ICT employees had to work overtime, probably being paid an overtime premium.

[19] The new Insolvency Statute which came into effect on 1 January 1999 replaced the previous Bankruptcy and Settlement Codes (Konkursordnung and Vergleichsordnung) in Western Germany as well as the Act on Collective Enforcement (Gesamtvollstreckungsordnung) in the Eastern German states.

vency procedure will eventually result in liquidation of the firm. Further, an insolvency procedure can now be initiated in cases which were not permitted before 1999, e.g., in the case of only a risk of insolvency.[20] Therefore, an increase in the number of insolvencies in Germany after 1999 may at least partly be attributable to the reform of the Insolvency Statute, leading to a structural break in the time series and thus limiting its ability to approximate the development of firm closures.

The development of insolvencies in Western and Eastern Germany as well as the course of de-registrations in the UK are depicted in Figure 2-2. As in the case of firm foundations, Figure 2-2 shows index series which are normalised such that the sector-specific number of insolvencies (de-registrations) in 1995 is set to the index value 100. The number of insolvencies in the Western German software and service sector rose tremendously from 2000 to 2001. This development corresponds to a contemporaneous decrease in the number of newly founded software and service firms. Those factors that are responsible for the downturn of foundation activities in the service sector likewise deteriorate the business situations of incumbent companies – either on the demand or the supply side – resulting in a higher number of firms exiting the market. Moreover, the rising number of firm closures in most recent years is likely a result of increased competition on the market: As shown above, a growing number of firms entered into the (Western German) software and service sector during the 1990s. These newly founded firms compete with incumbent companies for a limited number of customers. Only firms that launch superior software programmes and services are able to survive, while the other enterprises will be put out of business. In this respect, the rising number of firm closures after 2000 reflects the dynamic foundation activities in this sector during the 1990s.

Similarly to Western Germany, the index series of firm closures in the software and service sectors in Eastern Germany and the UK increased steadily from 1995 to 2002, while the increase of the Eastern German series was temporarily interrupted by a reduction in the number of insolvencies from 1997 to 1998. The downturn in the number of firm foundations in the UK after 1998 (in Eastern Germany: after 2000) was accompanied by a growing number of firm closures, although the rise was less pronounced than in the Western German case. Both in (Western and Eastern) Germany and in the UK, these developments militate in favour of increased competition in the software and service sectors in both countries. In the last year recorded by the databases, the number of insolvencies and de-registrations in the software and service sector declined slightly in

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[20] Note that in the ZEW foundation panel, an insolvency is recorded when the insolvency procedure is either opened or refused. Such a refusal occurs if the firm has been judged to be unable to cover even the direct bankruptcy costs (Almus et al. 2000a, p. 38).

Figure 2-2: Firm Closures in Aggregated High-Tech Sectors
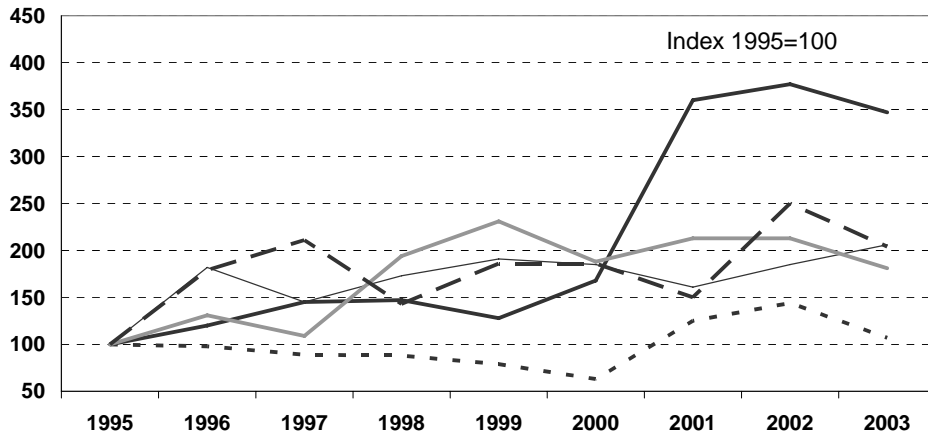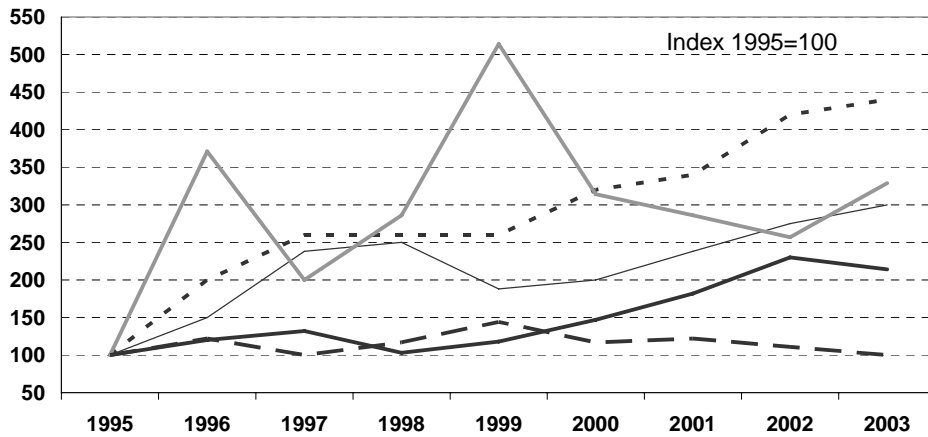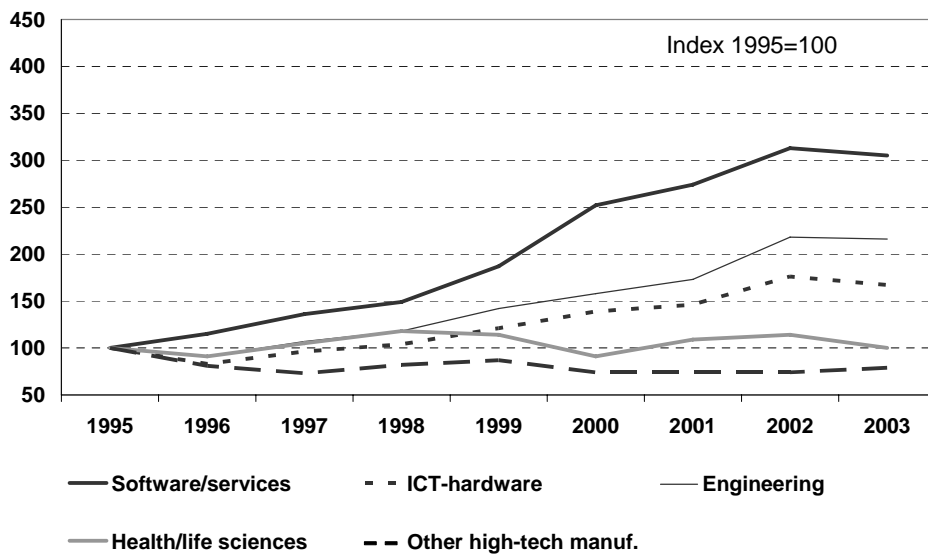
West Germany

Index 1995=100

East Germany

Index 1995=100

UK

Index 1995=100

——— Software/services   - - ICT-hardware   ——— Engineering

——— Health/life sciences   — — Other high-tech manuf.

The UK sector "other high-tech manufacturing" includes the complete NACE group 241.

Source: ZEW Foundation Panel, Small Business Service Statistics Team, own calculations.

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Germany as well as in the UK. In Western Germany, this decline was associated with a slight increase in the number of newly founded service firms from 2002 to 2003 – perhaps initial evidence of an economic rebound in this sector.

The number of insolvencies in three of four Western German manufacturing sectors (engineering, health/life sciences, other high-tech manufacturing) doubled from 1995 to 2003. In conjunction with the downturn in the number of firm foundations in these sectors after 2000, a rather discouraging picture emerges: The poor prospects in most high-tech manufacturing sectors induce an incrementally decreasing number of entrepreneurs to start new businesses. At the same time, the rising number of insolvencies seems to confirm the entrepreneurs' pessimistic expectations. The development of the level of insolvencies in the ICT-hardware sector was slightly different: The number of insolvent ICT-hardware firms in Western Germany declined from 1995 to 2000. In the following year (i.e., from 2000 to 2001), however, the level of insolvencies doubled and rose further by 15 % from 2001 to 2002. In the 1990s, the increasing diffusion of information and communication technologies presented favourable business conditions for incumbent Western German firms in the ICT-hardware sector, improving their chances of survival – in particular because there were relatively few newly founded firms that challenged incumbent companies. In most recent years, however, the demand for ICT components in Western Germany decreased (see below). Thus, the increased competition for a declining amount of demand led to a rising number of bankruptcies and market exits.

In Eastern Germany, the index series in Figure 2-2 indicate a tremendous increase in the number of insolvencies in the aggregated manufacturing sectors. Only in the sector of other high-tech manufacturing did the level of insolvencies remain constant over the regarded time period. However, we should be cautious in interpreting index series: In 1995, there were just five insolvency proceedings in the Eastern German ICT-hardware sector. Similarly, in the engineering sector the number of insolvencies amounted to eight in 1995. In the sector of health/life sciences there were seven insolvencies recorded in the Creditreform database. In contrast, the sector of other high-tech manufacturing revealed 18 insolvencies in 1995. In this case, the respective index series does not show a percentage increase similar to that of the other manufacturing sectors. In 2003, the number of insolvencies in each high-tech manufacturing sector in Eastern Germany amounted to approximately 20 cases. As discussed above, the number of firm foundations in East Germany is also relatively small. Considering further that insolvencies represent only a part of all firm closures it does not come as a surprise that such a small number of insolvencies is recorded in the database. Moreover, it has been argued that the first half of the 1990s in East Germany was characterised by the build-up of an entirely new stock of privately owned, independent firms. Thus, in 1995, the

Eastern German stock of enterprises consisted of some heavily subsidised, privatised companies and a large number of newly founded firms. According to Prantl (2003), small start-ups in East Germany seem to have occupied market niches that were empty before, and thus experience low exit risks. During the first years of the transition from a planned to a market economy, start-ups were able to profit from first-mover advantages in their market niches. Further, as Prantl argued, Eastern German entrepreneurs seem to have taken time to gain market experience before realising liquidations in way comparable to Western German firms. This may explain the relatively small number of insolvencies in Eastern Germany in 1995. Nevertheless, like their Western German counterparts, East German manufacturing firms are confronted with the same demand- and supply-side effects that aggravate the business conditions faced by high-tech firms and that are probably responsible for the observed rising number of insolvencies in most recent years.

The number of de-registrations in the UK manufacturing sectors evolved differently. In those sectors which experienced a below-average dynamic of firm foundations, notably the sectors of health/life sciences and other high-tech manufacturing, the number of firm de-registrations has remained constant over the past eight years. In the ICT-hardware as well as in the engineering sector the number of firms de-registering from VAT increased after 1998, the year in which the sector-specific number of firm formations attained its maximum. As has already become apparent for most (but not all) German sectors, the number of start-ups and the number of firm closures – the latter approximated by the number of insolvencies and VAT de-registrations – often develop in direct opposition to one another. Those (demand- or supply-side) factors that discourage entrepreneurs from setting up new businesses also deteriorate the business situations of incumbent firms, leading to a rising number of bankruptcies and voluntary firm closures.

Firm formations and closures are not only a result of macroeconomic factors influencing the individual decision to start a new business or the probability of a firm being liquidated. Formations and closures are also key elements of an economy's structural change. Thus, it is not sufficient only to examine the development of firm foundations and closures. The ratio between these two figures is important, since it determines the net gain or loss in a sector's stock of enterprises. Unfortunately, the German data do not allow calculation of changes in the stock of enterprises, since it is not possible to give an accurate estimate of voluntary firm liquidations. Thus, the following analysis is restricted to the UK.

As shown in Table 2-3, the stock of firms in the sector of heath/life sciences remained constant from 1994 to the beginning of 2004. Neither the number of start-ups nor the number of firms de-registering from VAT revealed any significant increases or declines. Between 100 and 130 start-

ups and closures were recorded annually in the database. Thus, the foundation rate in this sector, defined as the proportion of firms observed on January 1st that were founded in the previous year, amounted to 6.8 % in 2002. The sector of other high-tech manufacturing is the largest manufacturing sector in the UK. However, the number of firms operating in the market is decreasing continuously. Between 1994 and 2004, the number of registered firms fell by 18 %. This decline is not a result of a rising number of firm closures but of a falling number of newly founded firms. This finding becomes even more evident when the foundation rates in this sector are calculated: Whereas in January 1995 6.6 % of all registered firms were founded in the previous year, this ratio decreased to a value of 4.1 % in January 2004. Thus, the sector of other high-tech manufacturing is characterised by a falling rate of replacement of its stock of enterprises. In the two remaining manufacturing sectors, notably the ICT-hardware and engineering sectors, the stock of firms rose considerably from 1994 to 2000. Accordingly, the foundation rates increased and attained their maximum values in 1999: In January 1999, 13.2 % (10.4 %) of all firms operating in the ICT-hardware (engineering) sector were founded in 1998. However, as a consequence of the declining number of firm formations and the contemporaneous rise in the number of firm closures, the stock of enterprises decreased significantly in both sectors and even fell below its 1994 value.

Table 2-3:   Stock of VAT-Registered Enterprises in the UK

	Software/ services	ICT-hardware	Engineering	Health/life sciences	Other high-tech manuf.
1994	43.755	3.750	3.810	1.635	5.310 [a]
1996	59.120	3.740	3.905	1.640	5.115
1998	82.895	4.185	4.210	1.655	5.055
2000	106.865	4.385	4.480	1.630	4.840
2002	112.620	4.235	4.370	1.620	4.635
2004	105.535	3.385	3.675	1.600	4.350

[a] Number includes the complete NACE group 24.1.

Number of registered firms on January 1st. Numbers are rounded to the nearest five.

Source: Small Business Service Statistics Team, own calculations.

The software and service sector not only exhibits the largest stock of enterprises, it also experienced the highest growth rates in the stock of firms during the 1990s. Establishing a new service firm generally requires less resources than forming a manufacturing firm, leading to lower barriers to entry and hence to higher foundation rates: From 1995 to 1999, the annual foundation rates amounted to about 25 %, i.e., one quarter of all service firms that were operating in the market at any given time within the period did not yet exist one year before. Since the number of firm closures in the UK service sector was significantly smaller than the respective number of firm founda-

tions, the stock of service firms increased in the 1990s. Even after 1998, when the level of start-ups was already declining, a net gain in the sector's stock of enterprises occurred. Only in the last two years (i.e., 2002 and 2003) did the number of de-registered service firms exceed the number of start-ups in this sector. The stock of high-tech service firms thus declined by 6.3 % from January 2002 to January 2004. Nevertheless, the number of firms in the service sector had more than doubled in the previous decade. In the 1990s most newly founded firms were able to establish themselves in the market and only relatively few incumbent companies were crowded out. This development was only possible because it was accompanied by a rising demand for software and other high-tech services.[21] However, this convenient situation has changed: Although the number of newly founded software and service firms has declined significantly, the firms are currently faced with increased competition compelling a rising number of firms to exit the market.

The development of the stock of high-technology service firms is an indicator of a structural change towards a service-oriented and technology-based economy: Whereas in 1994 the share of software and service firms in all VAT-registered enterprises in the UK amounted to only 2.7 %, this ratio increased to 5.8 % in 2004. The structural change in the UK economy is less evident when regarding the manufacturing sector: In 1994 the stock of high-tech manufacturing firms (i.e., the sum of the four sectors) accounted for 8.8 % of all registered manufacturing firms.[22] Due to the dynamic foundation activities in the ICT-hardware and engineering sectors, this proportion rose to 9.3 % in 2000. Afterwards, however, it declined again, reducing to a value of 8.4 % in 2004.

2.3   Development of Sales in Aggregated High-Tech Sectors

Sales prospects are a major factor that determines the individual's decision to set up a new business. Similarly, a firm's growth prospects and its probability of survival are both influenced by the (potential) demand for the firm's products and services. Therefore, this section examines the development of the demand for high-tech products and services, with demand approximated by domestic firms' sales. In a first step, the importance of high-tech (manufacturing) sectors is illustrated by calculating the share of sales generated by each high-tech manufacturing sector in the manufacturing sector's total sales. Thereafter, I will discuss the development of sales in the five high-tech sectors during the last decade. In particular, the extent to which the development of sales at the time of the first survey this study is based on (i.e., 1997) differs from the situation at the time

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[21]   The development of the demand for high-tech services will be discussed in the following section.

[22]   The share of high-tech manufacturing firms in all registered firms in the UK is less than one percent, since the stock of enterprises is numerically dominated by service firms.

of the second survey (i.e., 2003) will be pointed out. Considering the purpose of this study, i.e., examining the export behaviour of young high-tech firms, sales prospects on the foreign market are an important aspect when describing the demand conditions for high-tech firms. The available data on the German manufacturing sectors allow a distinction between domestic and foreign sales. Therefore, the percentage of sales German manufacturing firms generate in the foreign market is briefly discussed at the end of this section.

Of course, sales and demand are not equal. Sales are the equilibrium quantity, valued at the equilibrium price, where demand on a market equals the amount supplied. If at a given time the demand exceeds the supply, the equilibrium price will rise, inducing either market entry of new firms, an expansion of incumbent firms' production, or increasing imports. Such a situation can be expected on growing, high-technology markets – at least during the market's expansion stage. Since demand will be approximated by domestic firms' sales, the share of domestic demand which is accommodated by imports is not considered. On the other hand, domestic firms' sales also include exports, reflecting the firms' sales prospects on the international market.

Data on sales generated by German high-tech firms are collected by the Federal Statistical Office. In order to compute aggregated sales in the four manufacturing sectors, data from the office's monthly reports on manufacturing plants are used, which cover all plants in the German manufacturing sector with at least 20 employees. Sales data on the German software and service sector were taken from VAT statistics. The UK sales data originate from the small and medium-sized enterprise statistics collected by the Small Business Service Statistics Team. All sales data exclude VAT and are discounted using producer price indices (PPI).[23]

For both Germany and the UK, I excluded telecommunication services (NACE code 64.2) from the sales data of the software and service sector presented below. Admittedly, the telecommunication industry plays an important role in the development of the high-tech sector. Its sales exceed those of computer services (NACE code 72.0) in the majority of cases.[24] However, this section intends to approximate the demand conditions of the technology-oriented firms that will be examined in the following chapters. Among those firms that were retained for the econometric analyses, there is not a single telecommunication firm. Even the random sample that contains all of the firms that were contacted by the joint Anglo-German research team (see chapter 3) includes only a few

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[23] The data sources are explained in more detail in appendix A.1.

[24] In 2003, the sales of the UK computer service sector (NACE code 72.0) amounted to £ 55,590 million, whereas £ 59,450 million were generated by the telecommunication industry (NACE code 64.2).

Table 2-4:   Sales in Aggregated High-Tech Manufacturing Sectors in 2003

	Germany		UK	
	in € millions	%	in £ millions	%
ICT-hardware	42,200	3.15	17,886	4.01
Engineering	22,818	1.70	10,113	2.27
Health/life sciences	42,064	3.14	16,647	3.74
Other high-tech manuf.	111,640	8.33	45,283 [a]	10.16
in comparison: Manufacturing sector [b]	1,340,578	100	445,565	100

[a] Number includes the complete NACE group 24.1;   [b] NACE code section D.

For further explanations of data sources: see text and appendix A.1.

Source: Federal Statistical Office, Small Business Service Statistics Team, own calculations.

telecommunication firms. Thus, the relevant demand for the service firms in our sample is best represented by sales generated in the computer service industry.[25]

Table 2-4 illustrates the turnover of German and UK-based firms in the four high-tech manufacturing sectors.[26] In order to demonstrate the importance of the high-tech sectors examined in this study, the share of sales generated by each of the four high-tech sectors in the manufacturing sector's total sales was calculated. In Germany, 16.3 % of the manufacturing sector's sales in 2003 corresponded to a high-technology industry. The respective value in the UK amounted to 20.2 %. Measured by the volume of sales, the sector of other high-tech manufacturing is the largest among the four sectors in both countries. This finding corresponds to the data presented in Table 2-3, which reveal that the UK sector of other high-tech manufacturing accounted for the largest stock of enterprises among the four regarded manufacturing sectors. However, with respect to the number of newly founded firms, the sector of other high-tech manufacturing did not have a leading position during the last decade. In particular, the number of firm formations in the ICT-hardware and engineering sectors exceeded the corresponding figure for the sector of other manufacturing firms, militating in favour of a structural change between the different high-technology manufacturing industries.[27]

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[25]   The firms in our sample were founded between 1987 and 1996. In Germany, however, the telecommunication sector was not liberalised until 1998. Before the liberalisation, the number of newly founded telecommunication firms was very small in Germany, since, in most cases, market entry was prohibited by law. Thus, the probability for selecting a German telecommunication firm by the chosen sampling procedure was relatively small.

[26]   Note that due to the varying coverage of the two country-specific data sources the absolute volumes of sales given in Table 2-4 are not comparable between Germany and the UK.

[27]   Due to the significant decline in most recent years, the level of firm foundations in the ICT-hardware and engineering sectors in the UK fell below the respective value of other high-tech manufacturing in 2003.

The development of the sectors' aggregated sales during the last decade is depicted in Figure 2-3. As before, the data are normalised, setting the sector-specific volume of sales generated in 1996 to the index value 100.[28] Sales in the software and service sector increased tremendously during the observation period. Even in most recent years, which have been characterised by a significant decline in the number of newly founded service firms and a contemporaneous rise in the number of firm closures, domestic service firms' sales kept on increasing. However, UK data revealed that despite the observed downturn in the number of firm foundations, the stock of service firms operating in the market continued to rise until 2002. Anticipating further a result of the analyses in chapter 5 indicating that most service firms examined by this study exhibited positive sales growth rates between 1997 and 2003, the increasing volume of domestic firms' sales does not come as a surprise. In the UK, merely the annual growth rate of the aggregated volume of sales declined from 2002 to 2003. In Germany, on the other hand, domestic service firms experienced a slight decrease in their sales from 2001 to 2002 (the last year for which sales data on the service sector are available), but this reduction is probably only a temporary phenomenon and not a first indication of a long-run downturn in the sector's volume of sales: From 2002 to 2003, the number of insolvencies in the service sector (approximating the level of firm closures) decreased in both Western and Eastern Germany. Moreover, the number of newly founded service firms rose in Western Germany during the same period. Arguing that the development of the number of firm formations and closures is influenced by the entrepreneurs' sales prospects, the observed firm dynamics give reasons to expect a recovery in the German service sector. Thus, it can be concluded that, measured by the volume of sales, the software and service sector can be characterised as a growing market, although the growth rates slackened in the last recorded year.

The sales generated in the German ICT-hardware sector rose significantly from 1996 to 2000. This development reflects the increasing diffusion of information and communication technologies during the 1990s. Since the number of newly founded ICT-hardware firms was in steady decline in Germany during the nineties, the demand for ICT-hardware components was obviously accommodated by expanding sales of incumbent companies.[29] After 2000, aggregated (discounted) sales of German ICT-hardware plants decreased by 15 % until 2003. This decrease was accompanied by a tremendous rise in the number of insolvencies in the ICT-hardware sector in both Western and

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[28]   Before 1996, the German VAT statistics, from which the sales data for the German software and service sector were taken, were compiled on a biennial cycle. Thus, there are no data available for 1995.

[29]   Additionally, Germany increased its imports of ICT-hardware products. According to the Federal Statistical Office (Statistisches Bundesamt 2003), the import of ICT goods (as defined by OECD [2000]) increased by 107 % from 1995 to 2000.

Eastern Germany. According to Hempell (2004), a major reason for the decline in sales of German ICT-hardware plants was the relatively high dependence of investments in ICT hardware on the business cycle. Due to the macroeconomic stagnation in Germany in recent years, many firms abandoned or postponed a planned investment in ICT hardware (see Hempell 2004). Interestingly, firms' inclination to save was more pronounced with respect to ICT hardware than to software, for which the volume of sales decreased only slightly.

Figure 2-3: Development of Sales in Aggregated High-Tech Sectors
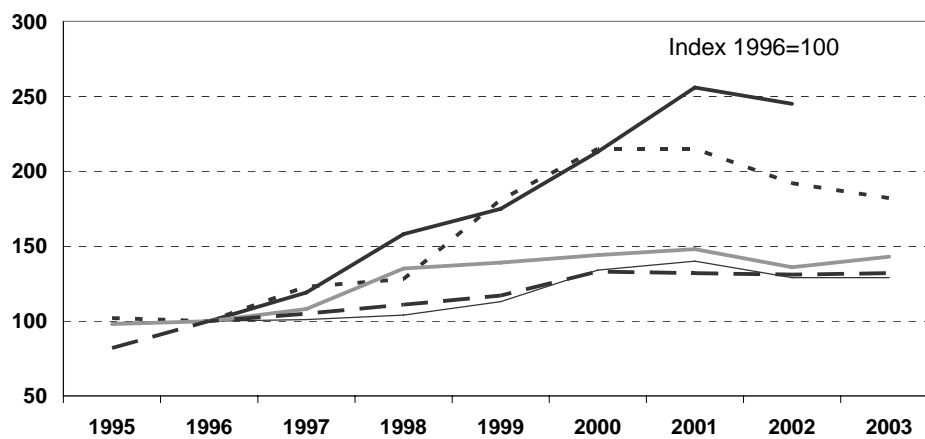
Germany

UK
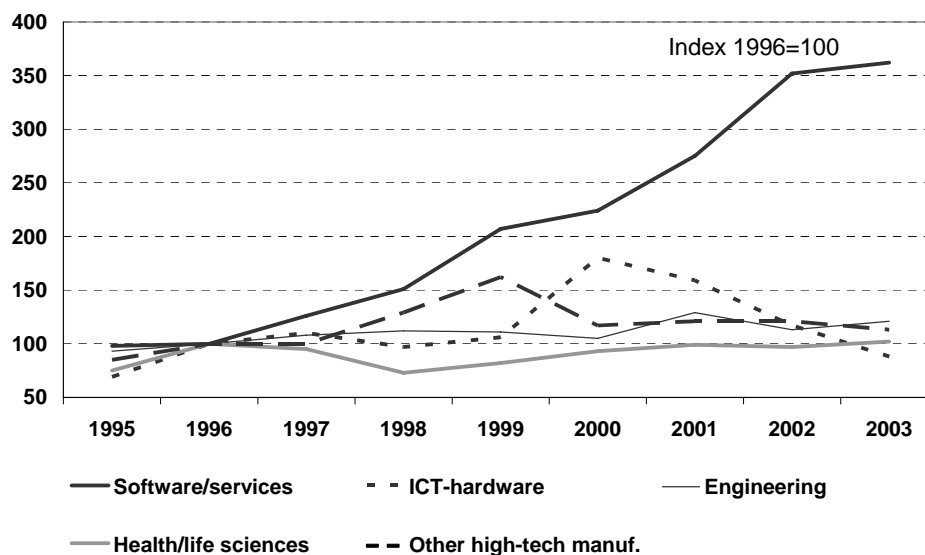
Index for the German software and service sector only covers computer services (NACE code 72).

Index for the UK service sector does not include telecommunication services (NACE code 64.2).

The UK sector "other high-tech manufacturing" includes the complete NACE group 24.1.

Indices were calculated using discounted sales.

Source: Federal Statistical Office, Small Business Service Statistics Team, own calculations.

In the three other high-tech manufacturing sectors in Germany, plants increased their sales from 1996 to 2000: Plants' turnover rose by 34 % in the engineering sector, 44 % in the sector of health/life sciences, and 33 % in the sector of other high-tech manufacturing. Afterwards, domestic plants' sales remained constant in these three sectors. Thus, as in the ICT-hardware sector, the positive development in the 1990s which offered favourable (growth) conditions for domestic enterprises in high-tech markets passed into a period of stagnating or even decreasing demand from 2000 to 2003.

UK-based ICT-hardware firms increased their sales by 80 % from 1996 to 2000. This development can be explained by a rise in the stock of ICT firms by 17 % in the respective period (see Table 2-3) and by growing sales on the part of incumbent companies. However, in accordance with the significant drop in the number of newly founded ICT-hardware firms and the declining stock of enterprises in this sector, the volume of sales generated by UK-based ICT-hardware firms decreased from 2000 to 2003, attaining a mere 88 % of the volume of (discounted) sales that were generated in this sector in 1996. Similar to Germany, the decrease in aggregated sales may be a reflection of UK-based firms abandoning or postponing investments in new ICT hardware, following a decade of continuously rising diffusion of information and communication technologies. Nevertheless, the extent of the reduction is surprisingly high, indicating that UK-based ICT-hardware firms are even more affected by declining demand than their German counterparts.

The sector of other high-tech manufacturing industries and the engineering sector in the UK both experienced rising demand after 1996. Although aggregated sales in 2003 fell below the maximum volume of sales the sector of other high-tech manufacturing industries (engineering sector) attained in 2001 (1999), sales were still significantly greater in 2003 than in 1996.[30] Thus, these two sectors are no longer characterised by growing demand, but the drop in demand was far less pronounced than in the UK-based ICT-hardware sector. However, it should be noted that the stock of enterprises that generated the 2003 volume of sales in both the engineering sector and the sector of other high-tech manufacturing firms was smaller than the respective stock of enterprises in 1996 (see Table 2-3 and the discussion in the previous section). Since the sector-specific volume of sales in 2003 exceeded that of 1996, the average volume of (discounted) sales generated by an individual firm had to be higher in 2003. Regarding the engineering sector, which exhibited the most significant rise in the number of firms de-registering from VAT among the UK-based manu-

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[30]   In some of the regarded industries, in particular aircraft and spacecraft manufacturing, sales data on an annual basis may be a bit misleading due to contract work the companies receive (e.g., to manufacture a certain number of airplanes). Thus, the variance of the demand for this sector's products is probably smaller than that of the reported time series indicating the development of sales.

facturing sectors, this means that competition in this sector led to increasing crowding out, but at the same time provided growth opportunities for incumbent firms. In the sector of other high-tech manufacturing industries the number of firm closures remained constant. However, since at the same time the number of firm formations declined continuously in this sector, the rising demand had to be accommodated by incumbent firms. In the smallest UK manufacturing sector, i.e. health/ life sciences, the volume of sales changed only slightly during the time period considered – neglecting the transitory decline in aggregated sales observed in 1998. This development corresponds to the below-average dynamic of firm foundations and closures in this sector.

Table 2-5: **Share of German High-Tech Manufacturing Plants'
Sales Generated Abroad (in %)**

	1996	2003
ICT-hardware	35.95	44.09
Engineering	36.85	46.64
Health/life sciences	34.90	50.90
Other high-tech manuf.	45.85	52.81

Source: Federal Statistical Office, own calculations.

In globalised markets, high-tech enterprises do not solely depend on domestic demand. They rather generate an increasing percentage of their total sales in the international market. This trend is highlighted in Table 2-5, which shows the share of exports in total turnover of German high-tech manufacturing plants.[31] From 1996 to 2003, the share of sales German plants generated abroad rose in each examined manufacturing sector. In 2003, approximately half of each sector's turnover was sold abroad. The large increase in German plants' sales which is depicted in Figure 2-3 is therefore mainly attributable to rising foreign sales. The plants were nevertheless able to extend the volume of sales they generated on their domestic (read: German) market, even though the growth rate of aggregated domestic sales was smaller than the respective rate plants realised on the foreign market. However, although the international market offers German plants additional market potential, this did not prevent a decrease in some sectors' volumes of sales. The declining sales in the ICT-hardware sector after 2000 were a result of a reduction in sales generated in both the domestic and the foreign market.

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[31] Comparable data for UK-based manufacturing companies or firms from the service sector are unfortunately not available.

2.4   Conclusion

The macroeconomic conditions young high-tech firms are faced with have changed during the last decade in both Germany and the UK. In the second half of the 1990s, high-tech markets were characterised by rather favourable conditions. In particular, aggregated sales generated by German and UK-based companies increased in almost all of the high-tech sectors examined. Technology-oriented firms did not only profit from increasing demand on their respective domestic markets. At least for German manufacturing firms, it was shown that the rise in sales was to a large extent attributable to firms' increasing sales generated on the foreign market. Although it cannot be proven with the data available, it is very likely that the foreign market is of similar importance for the UK manufacturing sector and, to some degree, for the software and service sectors in both countries. The favourable sales prospects in the late 1990s attracted new firms entering into the market. The number of firm formations increased tremendously in the software and service sector and, to a smaller extent, in most manufacturing sectors in Eastern Germany and the UK. The number of start-ups in the Western German manufacturing sectors decreased, but the rate of decline was rather modest – at least when compared with the development in most recent years. Of course, the large number of firm formations challenged incumbent firms, causing the market exit of the least efficient firms. Thus, on the other side of the coin, in most high-tech sectors the number of firm closures also increased in the late 1990s. However, the rising demand enabled newly founded firms to establish themselves in the market. As revealed by UK data, this led to a rise in the stock of enterprises in most of the high-tech sectors that were examined.

However, the high-tech sector experienced a downturn after the year 2000. The turning point in the development of the high-tech sector is in general associated with the end of the high-tech bubble on public markets (cf. Bank of England 2001). From 2000 to 2002, the number of firm foundations decreased in the five examined high-tech sectors in both Germany and the UK. In Western Germany, where the number of newly founded high-tech manufacturing firms was already declining in the late 1990s, the rate of decline rose significantly after 2000. In some German high-tech sectors, the number of start-ups increased again from 2002 to 2003 – possibly a first sign of recovery on these high-tech markets. The falling number of firm formations was accompanied by a further increase in the number of firm closures. At least in the UK, these two developments led to a reduction in the stock of enterprises. The downturn on high-tech manufacturing markets is also reflected by decreasing or constant sales. Thus, the period of growing aggregated sales has ended. At least for German manufacturing firms, this is true for both the domestic and the foreign market. Interestingly, aggregated sales generated by software and service firms continued to increase despite the decline in the number of newly founded service firms and the contemporaneous rise in

the number of firm closures. In Germany, aggregated sales in the software and service sector decreased from 2001 to 2002 only; in the UK merely the annual growth rate of the aggregated volume of sales declined from 2002 to 2003.

The changing macroeconomic environment has important consequences when examining the development of young high-tech firms. As will be discussed in the next chapter, this study's empirical analyses are based on a sample of high-tech firms that were surveyed in 1997 and again in 2003. Hence, the first survey was conducted when macroeconomic conditions were rather favourable for high-tech firms. Conversely, at the time of the second survey technology-oriented firms were faced with demand-side constraints. The demand for high-tech products is no longer growing, but constant or even decreasing in most sectors.[32] Thus, high-tech companies are challenged by intensified competition for a limited number of customers. Aggregated data reveal that the intensified competition led to a rising number of firm closures in both Germany and the UK. Thus, at the time of the second survey (i.e., 2003), the threat of failure was greater than at the time of growing high-tech markets before 2000. Firm managers have therefore had to develop appropriate strategies in order to guarantee their firms' survival and growth. For instance, firms may extend their R&D activities, and indeed, the subsequent empirical analyses will confirm the strategic role of investments in R&D. There are many strategic decisions firm managers have to make that will not be examined by this study. In particular, firms' financial strategies will be neglected. For instance, a successful firm may be able to finance its investment using previously earned profits. Alternatively, a high-tech firm that has become established in the market may be able to acquire long-term loans from banks. However, among the wide range of strategic options firm managers may exercise, this study will concentrate on firms' export strategies and their effect on the performance of the firms surveyed. In fact, the rising importance of globalised markets was already highlighted in Table 2-5, where it was shown that the share of aggregated sales German manufacturing plants generated in the foreign market increased significantly from 1996 to 2003.

Since the econometric analyses of this study are based on survey data, the observed strategies of the firms in our sample were at least successful in the sense that they guaranteed the firms' survival over the entire period from 1997 to 2003. Nevertheless, survey data reveal that there are still significant differences between individual firms with respect to other performance indicators like productivity or growth. Whereas some companies shrank after 1997, other firms exhibited relatively high (positive) growth rates from 1997 to 2002 (see chapter 5). This finding is in line with

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[32] Of course, high-tech firms may also be constrained from the supply-side, for instance, by a limited availability of finance and skilled employees. Regardless of the importance of supply-side restrictions for the development of young technology-oriented firms, they are neglected in this section.

the development of aggregated sales as discussed above. In almost all German and UK high-tech sectors the aggregated volume of sales in 2003 was higher than in 1996. In particular, aggregated sales generated in each country's software and service sector increased tremendously after 1996 and continued rising even after the year 2000. Thus, the intensified competition in the high-tech sector after 2000 led to increasing crowding-out of the least efficient firms, but at the same time provided growth opportunities for surviving firms. This study will try to discover which firm-specific characteristics facilitate the firms' growth processes and enable them to exploit growth opportunities even in a period when firms are faced with demand-side (and supply-side) constraints.

3   Description of the Data Set

The data for this study's empirical analysis result from two surveys carried out simultaneously in Germany and the UK. The firms were first contacted in winter 1997/1998 via a written questionnaire. The first survey was carried out by the London Business School in the UK and the Centre for European Economic Research (ZEW) in Germany. 362 completed questionnaires returned from the UK and 232 returned from Germany, resulting in a combined net sample of nearly 600 NTBFs from the two countries. In order to determine the development and internationalisation status of this sample of 600 NTBFs, a joint research team from the University of Exeter and the ZEW prepared a new survey in which all previously responding firms were to be contacted a second time. The second survey was conducted in 2003 via computer-aided telephone interview (CATI). 244 firms from the original sample participated in the second survey. After performing several consistency checks, 217 companies were retained in the data set for this study's econometric analyses. This chapter will describe the research designs of both surveys – including the stratification and sampling procedures – starting with a presentation of the mail survey conducted in 1997. In this chapter's last section, I will discuss to which extent the data set is affected by a survival bias and a non-response bias.

One major objective of the first survey was a comparison between the export behaviours of German and UK-based firms. Differences in the firms' international business activities can be traced back to a varying endowment with firm-specific resources, to different effects of the exogenous variables on high-tech firms' export activities, or to "soft" factors like differences in business culture. The last effect is indeterminable based on our data set. The other two effects could in principle be estimated. This would require country-specific econometric analyses. However, since our final data set comprises only 217 companies, country-specific estimations are impossible. The consequences of this shortcoming of our data set will briefly be discussed at the end of section 3.2.

3.1   Mail Survey Methodology (1997)

The first survey, conducted in 1997, was described in detail in the corresponding research report (Bürgel et al. 2004). This section summarises the main steps of the postal survey.

The rationale of the 1997 research project was to address the internationalisation, that is, export behaviour of newly founded technology-based firms (NTBFs). In his influential study, Little (1977) defined an NTBF using three criteria: The firm must not be older than 25 years, it must have been founded as a legally independent company by one or more individuals – thereby exclud-

ing subsidiaries, de-mergers or firms that were founded as a management buy-out (MBO) or buy-in (MBI) – and the firm's business idea must be based on the exploitation of an invention or a technological innovation (a firm's technological focus).

Little's definition includes firms as old as 25 years. However, more recent studies (e.g., Storey and Tether 1996) regard firms of this age as already having reached a mature stage of their life cycles. Thus, in accordance with other studies on NTBFs, the research team responsible for the first survey restricted themselves to firms that were ten years of age or younger at the time the survey was taken. In order to meet the criterion of legal independence, firm representatives were asked whether their company was founded as an independent new firm or was set up as a subsidiary, or following a de-merger, a management buy-out or a buy-in. Only legally independent firms were retained for the analyses.[33] Finally, only firms that were operating in one or more high-tech sectors as defined by Butchart (1987, see section 2.1) were selected, satisfying Little's criterion of a technological orientation.

In addition to the three above-mentioned selection criteria, the research team from the London Business School and the ZEW imposed one further condition: Only firms with at least three employees (in full-time equivalents, including the entrepreneurs) at time of the latest update of each individual firm's record in the databases of Creditreform and Dun & Bradstreet were considered for the sampling procedure (see below). This additional criterion was included for the following reasons: In the databases of credit rating agencies like Creditreform and Dun & Bradstreet, micro firms are not entirely covered. This impedes generalising our findings for the whole population of micro firms since it is unknown whether the micro firms included in the databases appropriately represent the population. For example, micro firms that tend to pro-actively exploit their domestic and foreign markets are more likely to be recorded in the databases of Creditreform and Dun & Bradstreet because of their above-average scope of credit demands and business activities (see Box 2-1). Thus, the databases of credit rating agencies are likely to be biased samples of the populations of micro firms. This problem does not disappear altogether for larger firms, but the extent of the bias decreases with firm size.

Another reason for the introduction of the additional size criterion was the well-known fact that the probability of responding to (mail) surveys is positively correlated with firm size; this means that

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[33] The source data sets used for the survey originate from Dun & Bradstreet in the UK and from Creditreform in Germany (see the explanations below and in Box 2-1). The statistical unit of both databases is the legally independent company. Thus, in most cases it is possible to distinguish between an original start-up and other derivative foundation events. However, in some cases the firm history might not be recorded entirely, prohibiting identification of a possible derivative foundation. Therefore, in order to guarantee that only original start-ups were analysed, firm representatives were asked to indicate the mode of firm formation in the written questionnaire.

the smallest firms generally exhibit the lowest inclination to participate in a survey. In order to obtain a sufficiently high number of responses enabling us to draw reliable conclusions for the population of micro firms, a relatively high amount of resources would be necessary. Considering that time as well as financial and human resources are always limited, firms with fewer than three employees were neglected.

The final reason for the exclusion of micro firms from the target sample was the assumption of the Anglo-German research team that these firms are not very likely to be engaged in international markets – for example, because of their limited resources. Under this assumption, the internationalisation behaviour of young technology-based firms can best be represented by firms whose size exceeds a certain threshold. However, taking into account the results of the first survey, this assumption cannot be confirmed. Even within the group of the smallest firms that were contacted, a relatively high percentage of firms were internationally engaged at the time of the first survey. Thus, it became evident *ex post* that if a minimum size required for international business activities exists, it will be far smaller than the research team's initial expectations.

After determining the selection criteria, suitable sources of primary data had to be identified. The research team decided to use the database of the respective country's leading credit rating agency, i.e., Creditreform in Germany and Dun & Bradstreet in the UK. Creditreform and Dun & Bradstreet both have a comprehensive database of firms at their disposals. Moreover, since their data are collected for the same purposes and in a similar way, the choice of these two data sources guaranteed that the sample selection process would be comparable in the two countries.

Applying the selection criteria discussed above, it was possible to identify 26,433 German companies from the Creditreform database that were still alive in 1997: 19,125 in Western Germany and 7,308 in the eastern part of Germany. 381 Eastern German firms had to be excluded because they were identified as former state firms of the German Democratic Republic (so-called "Treuhandunternehmen", or "trustee firms"). Public limited companies ("Aktiengesellschaften", AG), registered societies ("eingetragene Vereine", e.V.), and registered co-operative societies ("eingetragene Genossenschaften", e.G.) were excluded. Furthermore, firms of which more than 25 % of the individual firm's equity were owned by other companies and firms with more than 50 employees at the time of start-up were also left out of the sample. The former group of firms was assumed to be controlled by another company, thus violating the criterion of legal independence. Similarly, since most original firm formations are very small (cf. Harhoff and Steil 1997), only enterprises that were established with a workforce of less than 50 employees were defined as original start-ups. Larger firm foundations were assumed to be derivative foundation events or subsidiaries of

other companies. It was supposed that Creditreform had not recorded the entire history of these firms, leading to their incorrect classification as original start-ups. This procedure corresponds to that used for the preparation of the ZEW foundation indicators (see Engel and Fryges 2002). Likewise, it is applied in other studies examining foundation activities (see, e.g., Audretsch and Fritsch 1992). In the UK, 7,788 technology-based firms that had been founded between 1987 and 1996 and had survived until 1997 were identifiable in the Dun & Bradstreet database. Dun & Bradstreet generously made this data set freely available to the Anglo-German research team.

In addition to the codified information, the databases of both Creditreform and Dun & Bradstreet contain free-flow texts describing each firm's line of business. All of these descriptions were carefully screened by members of the research team in order to ensure that the selected firms really were engaged in at least one high-tech industry and were not misleadingly coded. This was carried out using various "negative" criteria for a text field search. More precisely, firms whose aforementioned free-flow texts included keywords like "retail", "wholesale", "distribution", "maintenance", or "repair" were identified and excluded from the sample. Further, firms that only ran a computer call centre (NACE code 74.83, secretarial activities) were often incorrectly codified as providers of telecommunication services (NACE code 64.2). They were likewise removed from the sample.

Another problem emerged because the database of Dun & Bradstreet was classified by the US 1982 SIC code. According to this classification, computer-related services (SIC codes 73.72 and 73.79) include firms that primarily provide preparation of computer software documentation and installation of software on a contract- or fee basis. Since it is not very likely that the normal business activities of these firms entail regular R&D activities, they were identified using the text field search described above and were not considered for the sampling procedure. Altogether, a final sample of 5,045 German and 3,562 UK-based firms (hereafter called the "population") was obtained and deemed appropriate for the subsequent sampling procedure.

Each country's population was stratified by size class, sector (manufacturing versus services), and, for Germany, by region (West and East Germany). The sample composition of the population is given in Table 3-1. In order to obtain a target sample of 2,000 firms in each country for the mail survey, a target number of firms per cell was determined. The research team decided on separate strata for West and East Germany because there are no Eastern German NTBFs that were founded before 1990. Moreover, due to the exceptional economic situation in Eastern Germany after German unification, Eastern German firms were faced with macroeconomic conditions different from those experienced by firms in established market economies like Western Germany or the UK. In

Table 3-1:   Sample Composition of the Population and the Target Sample (1997)

Employees	Population (still living firms)			Target Sample		
	Manufacturing	Services	Total	Manufacturing	Services	Total
West Germany						
3-5	522	997	1,519	183	100	283
6-9	273	499	772	192	87	279
10-19	358	463	821	323	116	439
20 and more	379	300	679	379	117	496
Total	1,532	2,259	3,791	1,077	420	1,497
East Germany						
3-5	115	244	359	46	29	75
6-9	128	155	283	64	31	95
10-19	167	133	300	94	33	127
20 and more	242	70	312	171	35	206
Total	652	602	1,254	375	128	503
UK						
3-5	673	742	1,415	345	111	456
6-9	474	370	844	384	111	495
10-19	472	292	764	427	133	560
20 and more	362	177	539	345	144	489
Total	1,981	1,581	3,562	1,501	499	2,000

Source: Bürgel et al. (2004).

order to examine whether these varying macroeconomic conditions affect the internationalisation behaviour of Eastern German NTBFs, the latter were overrepresented in the target sample.

The research team intended to include approximately 1,500 manufacturing firms and 500 service firms in the target sample. Since its members were interested in estimating and testing industry-specific effects, each of the four high-tech manufacturing sectors had to be entered into the sample with a sufficiently high number of observations. In the case of a proportional random sample, half of the target sample would originate from the service sector. The overrepresentation of the manu-facturing sector guaranteed that a sufficiently high number of firms from each manufacturing sector would be contacted by the first survey. Finally, a roughly equal distribution of firms among different size classes was decided upon. Theory suggests that larger firms are more likely to have international business activities. Thus, an overrepresentation of larger firms increased the *ex ante* probability that a sufficient number of internationally active firms would be included in the target sample. Moreover, a broadly even distribution of firms among different size classes facilitates an examination of systematic differences between firms of different size. The sample composition of the target sample is shown in Table 3-1.

Table 3-2: Drawing Probability per Stratum

Employees	West Germany		East Germany		UK	
	Manufacturing	Services	Manufacturing	Services	Manufacturing	Services
3-5	37 %	10 %	43 %	13 %	51 %	15 %
6-9	75 %	18 %	52 %	21 %	81 %	30 %
10-19	92 %	26 %	60 %	25 %	90 %	46 %
20 or more	100 %	41 %	77 %	50 %	98 %	81 %

Note: The table shows the final drawing probabilities after inclusion of 74 (62) firms from the German (UK-based) reserve sample.
Source: Bürgel et al. (2004), own calculations.

Based on the target number of firms per cell, a stratified random sample of 2,000 companies for each country was drawn from the population. This procedure results in the drawing probabilities per stratum that are displayed in Table 3-2. Furthermore, a reserve sample of 617 German and 671 UK firms was drawn, roughly a third of the target sample for each country. The reserve sample was intended to replace firms in the second mailing that had ceased to exist or had moved and whose questionnaires returned unopened in response to the first mailing.

In parallel to drawing the target and the reserve samples, the written questionnaires were developed based on the existing literature on the internationalisation process of NTBFs. The written questionnaires contained questions regarding the profile of the firms' founders, product characteristics, international business activities, entry modes into foreign markets, and perceived opportunities and risks of international activities. After designing the questionnaires, the research team carried out six pilot case studies in the two countries (four in the UK and two in Germany). These case studies allowed the research team to discover whether the questions were exhaustive and

Table 3-3: Response Codes of the Mail Survey (1997)

Description	Germany		UK	
	N	%	N	%
Usable Questionnaires	*232*	*11.2*	*362*	*17.6*
Answered only the first questions	15	0.7	7	0.3
Refusal, questionnaire sent back	4	0.2	27	1.3
Refusal by mail or telephone	6	0.3	34	1.6
Firm does not belong to the target population	21	1.0	94	4.6
Firm not known at the address or firm moved, address unknown	5	0.2	134	6.5
Firm failed, no longer exists or is in receivership	3	0.1	9	0.4
No response at all	1,788	86.2	1,395	67.7
Total [a]	2,074	100	2,062	100

[a] 74 German and 62 UK firms that were involved in the first mailing were replaced by firms from the reserve sample.
Source: Bürgel et al. (2004).

understandable and whether they really measured what was intended by the team. The questionnaires were then modified in terms of both the layout and wording of the questions. The final questionnaires are presented in appendices A.2 (English version) and A.3 (German version).

The questionnaires were sent out to the target firms in October 1997, followed by three reminders at intervals of three to four weeks after the last mailing. 62 British and 74 German firms involved in the first mailing were replaced by firms taken from the reserve samples. These were firms that had ceased to exist or moved. As a result, 362 completed questionnaires returned from the UK and 232 returned from Germany (see Table 3-3). This corresponded to a (uncorrected) response rate of 11.2 % in Germany and 17.6 % in the UK. The net sample showed no bias with respect to age, size, or sector when compared with the target sample.

3.2   Telephone Survey Methodology (2003)

The data collected by the 1997 survey enabled the research team to carry out profound descriptive and econometric analyses, extending the knowledge of the export behaviour of technology-oriented firms in Germany and the UK during early stages of their life cycles. However, our knowledge of the development and the internationalisation status of high-tech companies as firms age and reach more "mature" stages of their life cycles is still limited. Therefore, a joint research team from the University of Exeter and the ZEW prepared a new survey in which all previously responding firms were to be contacted a second time.

In 2003, the companies from the original sample were an average of twelve years old. Thus, some of them were no longer definable as NTBFs – at least not according to the definition chosen by the Anglo-German research team, where only firms that were ten years of age or younger were regarded as "newly founded" firms. Considering this notion, we shifted our interest from analysing high-tech start-ups to a more longitudinal perspective of firm development.

The second column of Table 3-4 shows each country's 2003 population of high-tech firms; that is, those companies of the 1997 population that survived the following six years. Since we do not have reliable information on the survival status of each individual firm, the figures given in Table 3-4 constitute only an estimation of the 2003 population.[34] In Germany, 79 % of the 1997 popula-

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[34]   The estimation of the 2003 German population is based on the Creditreform database's information on firm closures. As explained in section 2.1, those firms labelled as "dead" by Creditreform have almost certainly left the market. The reverse, however, is not true: Voluntary firm closures are often only recorded after a considerable delay by Creditreform, causing the number of closed firms to be underestimated. In the UK, the research team drew a random sample for each stratum and subsequently determined the survival status of these companies using different data sources only available to the UK research team. Based on this information, the 2003 population of high-tech firms in the UK was estimated.

tion was still alive in 2003 (manufacturing sector: 82 %; service sector: 77 %). The survival rate of Western German firms (80 %) was only slightly higher than that of their Eastern German rivals (77 %). There are likewise only minor differences with respect to the size class German firms were assigned to in 1997, i.e., at the beginning of the time period that will be examined in this study. The overall survival rate of UK-based firms amounted to 83 %.[35] Interestingly, in contrast to the German subsample, the survival rate of firms in the smallest UK size class (87 %) is considerably higher than that of firms with 20 or more employees in 1997 (78 %).[36]

Table 3-4: Sample Composition of the Population and the Target Sample (2003)

Employees	Population (still living firms)			Target Sample		
	Manufacturing	Services	Total	Manufacturing	Services	Total
West Germany						
3-5	426	779	1,205	18	12	30
6-9	231	409	640	21	12	33
10-19	301	367	668	22	10	32
20 and more	319	213	532	27	3	30
Total	1,277	1,768	3,045	88	37	125
East Germany						
3-5	82	180	262	4	9	13
6-9	107	108	215	9	1	10
10-19	136	96	232	12	3	15
20 and more	196	56	252	21	4	25
Total	521	440	961	46	17	63
UK						
3-5	581	643	1,224	35	12	47
6-9	405	286	691	45	19	64
10-19	411	210	621	64	14	78
20 and more	277	141	418	36	18	54
Total	1,674	1,280	2,954	180	63	243

Note: The 1997 assignment of a single firm to a stratification cell was used.

Seven firms from the UK sample were no longer assignable to their old stratification cells.

Source: ZEW, University of Exeter.

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[35] Since the survival rates for the German and the UK subsample are determined in very different ways, they are not directly comparable. At best, it can be concluded that the data do not contain any evidence of significant differences between the country-specific overall survival rates. However, the survival rates can be compared between the four different size classes in each country.

[36] These descriptive results contradict various econometric analyses (e.g., Mata and Portugal 1994, Audretsch and Mahmood 1995) which found a positive effect of firm (start-up) size on the probability of survival. The relationship between firm size and survival is, however, beyond the scope of this study.

To determine the target sample of the second survey, all formerly responding firms that turned out to be mismatches (e.g., non-high-tech firms, non-independent foundations) were first excluded. Furthermore, each German firm labelled as "dead" in the Creditreform database (due to bankruptcy or voluntary firm closure) at the beginning of 2003 was eliminated from the new target sample. In the UK, firms that could be identified as dead by the researchers themselves were also excluded from the target sample. As a result, we produced and subsequently contacted a final target sample of 188 German and 250 UK-based former respondent firms. The sample composition of the 2003 target sample is presented in Table 3-4.

The second survey was conducted in summer 2003 via computer-aided telephone interview (CATI). The research team decided on a telephone survey because, due to the limited number of former respondent firms in the 2003 target sample, the assurance of a relatively high response rate and thereby a sufficiently high number of observations was necessary to obtain reliable econometric results.

The questionnaires of the telephone interviews were essentially based on the written questionnaires used for the first survey. The structure and the wording of the individual questions were almost identical in both surveys. This was necessary since the research team intended to compare the situations of the firms in the sample at the time of the two surveys and the firms' development over the period in between. Therefore, the wording of the questions was merely adjusted to meet the peculiarities of a telephone survey. Moreover, some minor changes in the wording of the questions were made when the research team was convinced that these changes would improve the comprehensibility of the individual questions – in particular in the German translation of the English questionnaire.[37] In both countries, about 30 companies were interviewed by phone in order to test the understandability of the questionnaires. Based on the experiences reported by the interviewers, the questionnaires were modified, resulting in the final versions shown in appendices A.4 (English version) and A.5 (German version).

Fortunately, in both the UK and Germany, the response rate exceeded 50 %, giving us a pool of 244 completed interviews (see Table 3-5). After performing several consistency checks, 217 companies were retained in the data set for econometric analysis. However, in contrast to the first survey in which a bias with respect to sector was not found, the ICT-hardware sector is underrepresented in the German as well as in the UK sample. On the other hand, the sector health/life sciences (engineering) is overrepresented in the 2003 German (UK) sample. An absolutely anony-

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37   For example, the research team decided to use another German translation of the English expression "tried and tested technology".

Table 3-5: Response Codes of the Telephone Sample (2003)

	Germany		UK	
	N	*%*	*N*	*%*
Completed interview	*103*	*54.79*	*141*	*56.40*
Refusal	45	23.94	49	19.60
Line occupied	7	3.72	0	0.00
Free line/answering machine	14	7.45	0	0.00
Open appointment (not realised)	3	1.60	0	0.00
Firm dead	4	2.13	31	12.40
No phone number available	2	1.06	0	0.00
Wrong phone number	7	3.72	0	0.00
Computer crash	1	0.53	1	0.40
Firm not contacted	2	1.06	28	11.20
Total	188	100	250	100

Source: ZEW, University of Exeter.

mous version of the data set (in STATA format), including a detailed description of the data, is available from the ZEW upon request.

The most important shortcoming of the data set is that due to the limited number of observations, country-specific econometric analyses are almost impossible. This is particularly true for the German subsample which comprises only 95 companies. The UK subsample is larger, but nevertheless contains only 122 firms. Considering further that the number of observations in a specific econometric model is typically reduced due to item non-response, a country-specific estimation of the models that will be derived in chapters 4 and 5 would eventually be based on less than 100 observations. Moreover, in the logistic regressions in chapter 4, the "success" sometimes constitutes a rare event in our data (e.g., the exit from the foreign market or the change of the foreign sales mode used). Thus, in each country-specific subsample the absolute number of "successes" is still smaller than in the pooled data set, making an estimation of the probability of the rare event impossible. But even if the respective econometric model can be estimated using the two country-specific subsamples, the resulting differences between the estimated coefficients in the two country-specific regressions are not significant in most cases. It is therefore difficult to prove econometrically whether the functional form of the regression model differs between the German and the UK subsamples. For these reasons, I will not present country-specific regressions in chapters 4 and 5. It has, however, to be borne in mind that differences between German and UK-based firms' export activities that are apparent from the descriptive analyses are either a result of different effects of the exogenous variables on the firms' export behaviour, that is a different functional

form of the regression model between the two country-specific subsamples, or of the firms' varying endowments with firm-specific resources. Due to the limited number of observations in our data set, a decomposition of these two effects is, unfortunately, not possible.

3.3   Survival Bias and Non-Response Bias

The chosen research design implies that this study's empirical results may be affected by a survival bias as well as a non-response bias. The survival bias occurs because some firms of the examined cohorts from 1987 to 1996 did not survive until the time when the two surveys were conducted. Even the population from which the target sample of the first survey was drawn (cf. Table 3-1) did not represent all start-ups of the analysed cohorts since some firms already left the market until 1997. However, based on the available data sets, it is not possible to determine the number of firms that did not survive from start-up until 1997. As described above, about 20 % of the firms of the 1997 population left the market in the period from 1997 to 2003, leading to a second survival bias that influences the composition of the longitudinal data set this study's analyses are based on.

The survival bias has two important consequences: Firstly, the results are not representative for all technology-oriented firms founded between 1987 and 1996, but only for those that survived. The cross-sectional data set of the first survey represents young high-tech firms that were an average of six years old in 1997. Similarly, the cross-sectional data set of the second survey represents technology-oriented firms that were an average of twelve years old in 2003. Of course, the cross-sectional data set of the first survey comprises firms that exited from the market in the period between the two surveys. Thus, when comparing (descriptive) statistics that are calculated on the basis of the 1997 cross section with results that are obtained using the cross-sectional data set of the second survey, the comparison is inevitably affected by the survival bias. If the sample of still living firms is characterised by different characteristics than non-surviving firms, the (descriptive) statistics do not only reflect changes in the firm-specific characteristics over time, they also mirror differences between dissolved and surviving firms. Therefore, as the second important consequence of the survival bias, all statistics in this study will be restricted to those firms that participated in both surveys. This guarantees that increases or decreases in the statistics presented can be traced back to changing behaviour of the firms in our sample over time.[38]

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[38]   Restricting ourselves to those firms that participated in both surveys further implies that all statistics that are related to the time of the first survey deviate from those presented in Bürgel et al. (2004). It should further be noted that Bürgel et al. calculated weighted descriptive statistics (based on the drawing and responding probabilities in the individual strata), whereas I will only present unweighted descriptive statistics.

In addition to the survival bias, this study's results are affected by a non-response bias. Whenever the firm-specific characteristics of respondents deviate from those of non-respondent firms, the results are no longer representative for the population of young high-tech firms in Germany and the UK. Since we did not carry out a non-response analysis, we do not know whether there are differences between respondents and non-respondents. The non-response bias is particularly important for the first survey where we realised a response rate of only 11.2 % in Germany and a corresponding rate of 17.6 % in the UK. In the second survey, the response rates in both countries were relatively high (54,8 % in Germany and 56,4 % in the UK). This can be regarded as an indicator that the respondents of the 2003 survey do not differ systematically from the complete target sample from the 2003 survey (i.e., all respondents of the first survey that survived until 2003). This is important, because throughout this study we will compare the results of the first survey, as presented in Bürgel et al. (2004), with our own empirical results. Thus, it is unlikely that such a comparison is affected by a non-response bias in addition to the survival bias that was described above. Nevertheless, it is impossible to determine the extent to which the non-response bias influences the representativeness of our longitudinal data set with respect to the population of (still living) NTBFs in 2003 (cf. Table 3-4). Since only the respondents of the first survey were contacted a second time, a possible non-response bias that was prevalent in the 1997 survey also affects the representativeness of both the 2003 target sample and the 2003 sample of responding firms.

4 Export Behaviour of Technology-Oriented Firms

The internationalisation of firms has multiple dimensions (cf. Sullivan 1994b). Perhaps the most apparent and most frequently discussed dimension of international business activities is the firms' export behaviour. Additionally, firms may import investment goods or components, i.e., internationalise on the procurement market. They may persuade foreign investors to invest in their company or they may themselves invest in foreign companies or build up a production subsidiary of their own abroad. Internationalisation is a demanding task for firm managers that involves having to make numerous decisions. For example, managers have to decide whether they want to expand their firms' business activities onto the international market or to remain a firm with domestic sales only. Provided that firm managers decided on entering the foreign market, they must select the target country to which they will export their products or services. In each target country the time of market entry and the optimal sales mode have to be determined. Of course, an international engagement is connected with various costs firm managers have to consider. Selling abroad may require adaptation of the firm's product or service to foreign regulations. Packaging and sales documentation may have to be modified. Reliable foreign partners must be identified and foreign sales channels must be set up. Furthermore, a firm's international engagement may be impeded by various factors, for instance, the limited international experience of firm managers or just a scarcity of management time. Thus, firm managers have to develop strategies in order to overcome these restrictions. Moreover, macroeconomic conditions as well as each firm's situation (e.g., a firm's available resources and capabilities) change over time. In this case, firm managers may be obliged to adjust their export strategy. As an extreme example, firm managers may regard it as optimal to exit from the foreign market.

Even though the aforementioned list is by far not exhaustive, it makes it clear that it is impossible to analyse firms' export behaviour in all its dimensions in this chapter. Considering this study's focus on high-tech firms' long-term international business activities, I will restrict myself to three dimensions of firms' international engagement: firms' foreign market entry and exit, the degree of internationalisation, and changes of sales modes in international markets. Before examining these three dimensions, I will discuss various theories of internationalisation that will provide a basis for the subsequent empirical analysis. As Bürgel et al. (2004) stated, there is no single theoretical model that is able to explain the internationalisation behaviour of a firm that is both young and operates in a high-technology sector – such as those that were observed by the two surveys. Therefore, I will fall back on different models in order to motivate my empirical analysis (section 4.1).

Each of the three following sections 4.2 to 4.4, which contain this chapter's empirical analyses, is structured in the same way. Firstly, empirical studies that deal with the dimension of internationalisation examined in the respective section will be reviewed. I will also discuss the extent to which previous empirical results are transferable to the context of the long-term export behaviour of young and small technology-oriented firms. The second subsection will comprise descriptive analyses, followed by a presentation of the econometric model. Based on the theories reviewed in section 4.1, I will derive testable hypotheses on how the export behaviour of NTBFs is affected by various exogenous factors, i.e., the general internationalisation theories are transferred to the special case of NTBFs. In connexion with the derivation of the econometric model, I will also show how the different theoretical concepts are operationalised in the estimation equations. The fourth subsection presents the empirical results, and a final subsection concludes.

4.1   Theories of Internationalisation

Theories that try to explain individual firms' export activities can be categorised into models of economics and theories of international management. One basic approach in the field of economics is the model originally developed by Roberts and Tybout (1997), which was tested empirically by Roberts and Tybout themselves and by other authors in a series of papers (see, in particular, Bernard and Jensen [2004] and Bernard and Wagner [2001]). My theoretical considerations begin with a presentation of this model's core arguments. The second model of economics that will be presented is the dynamic model derived by Lautanen (2000). According to Lautanen, there are analogies between the adoption process of a new technology and small firms' decision to enter into the foreign market. Therefore, Lautanen's theory is based on models of technology diffusion.

Both Roberts and Tybout's and Lautnen's model include a vector of firm-specific variables that influence potential profit from international business activities and insofar determine a firm's decision to internationalise or not. However, mostly due to data restrictions, previous econometric studies have often contained only a relatively small number of observable firm characteristics. Since this study is based on survey data that were specifically collected to analyse the internationalisation behaviour of young and small high-technology firms, I am able to use a larger set of firm-specific characteristics. In order to identify variables that can be expected to discriminate between exporters and non-exporters, I used internationalisation theories from the field of international management. In the following, I will review the main arguments of three strands of theory: internationalisation process models (Johanson and Vahlne 1977, 1990), a theory of internationalisation from an entrepreneurial perspective (McDougall and Oviatt 2000, Andersson 2000), and the resource-based view (RBV) of a firm (e.g., Penrose 1959, Wernerfelt 1984). After entering into a

foreign market, a firm has to decide on an appropriate sales mode. The internationalisation process model and the RBV are also suitable for explaining a firm's choice of its foreign sales mode (see Malhotra et al. 2003). Additionally, I will discuss the organisational capability (OC) perspective of the firm (Madhok 1997), which is rooted in the RBV, and the transaction cost analysis theory (e.g., Williamson 1985, Anderson and Gatignon 1986) insofar as these two theories are relevant for an analysis of a firm's sales mode choice. Finally, the eclectic paradigm developed by Dunning (1993) will be presented. As a multitheoretical framework, Dunning's eclectic paradigm combines elements of all the theoretical approaches reviewed in this section.

Models of Economics

The first model under theoretical consideration was originally formulated by Roberts and Tybout (1997) and applied by Bernard and Jensen (2004) and Bernard and Wagner (2001), among others.[39] It is based on the theoretical literature on sunk costs developed by Dixit (1989a, 1989b), Baldwin (1988), Baldwin and Krugman (1989), and Krugman (1989). Roberts and Tybout assume that, in period t, a rational firm i maximises the profits π_{it} it receives by selling the profit-maximising level of exports q_{it}^* abroad. It is assumed that the firm is always able to produce the profit-maximising level of exports q_{it}^*. A firm's profit depends on factors exogenous to the firm X_{it}, such as exchange rates, and firm-specific variables Z_{it}, like firm size, age or product characteristics. Firm profit is given by

$$(4.1) \qquad \pi_{it}\left(X_{it}, Z_{it}\right) = p_t q_{it}^* - c_{it}\left(X_{it}, Z_{it} \middle| q_{it}^*\right).$$

where p_t is the price of goods sold abroad and c_{it} is the variable cost of producing quantity q_{it}^*. As long as there are no entry costs, the firm will enter the foreign market in period t if the period's profit is non-negative. The variable Y_{it} indicates the internationalisation status of firm i in period t and is defined as

$$(4.2) \qquad Y_{it} = \begin{cases} 1 & \textit{if } \pi_{it} \geq 0 \\ 0 & \textit{otherwise} \end{cases}.$$

Entering a foreign market, however, often causes costs, e.g., the costs of a marketing campaign or of setting up foreign sales channels, that may be regarded as sunk costs. Assuming that these sunk

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[39] Formulas and notation used in this section are identical to those used by Bernard and Jensen (2004) and Bernard and Wagner (2001).

costs N must be fully paid in each period t unless the firm had exports in the previous period t-1 (i.e. $Y_{it-1} = 1$), the one-period profit becomes

$$(4.3) \qquad \tilde{\pi}_{it}\left(X_{it}, Z_{it}, Y_{it-1}\right) = p_t q_{it}^* - c_{it}\left(X_{it}, Z_{it} \big| q_{it}^*\right) - N \cdot \left(1 - Y_{it-1}\right).^{40}$$

In a dynamic framework the firm chooses a sequence of export levels $\left\{q_{is}^*\right\}_{s=t}^{\infty}$ that maximises expected current and discounted future profits

$$(4.4) \qquad \Pi_{it} = E_t \left(\sum_{s=t}^{\infty} \delta^{s-t}\left[\tilde{\pi}_{is} \cdot Y_{is}\right]\right),$$

where δ is the one-period discount rate.

The introduction of sunk costs induces an option value of waiting and leads to a spell of inaction, a phenomenon known as "hysteresis" (Dixit 1989a). In fact, the main interest of Roberts and Tybout's study and the other papers cited above was to examine whether sunk costs are present and, if this is the case, to quantify their effects on the decision to enter and exit the foreign market. If sunk costs are relevant, firms may continue to export even if foreign sales are no longer profitable in the current period in order to avoid re-entry costs. According to this theory, a transitory depreciation of the respective domestic currency will cause a permanent (or at least long-term) increase in the number of firms involved in the international market, even if the domestic currency subsequently re-appreciates.

To measure the effect of sunk costs on the decision to internationalise, Roberts and Tybout estimate a binary-choice non-structural model of the form

$$(4.5) \qquad Y_{it} = \begin{cases} 1 & \text{if } \beta X_{it} + \gamma Z_{it} - N \cdot \left(1 - Y_{it-1}\right) + \varepsilon_{it} \geq 0 \\ 0 & \text{otherwise} \end{cases}.$$

In order to consider unobserved firm-specific heterogeneity, the error term ε_{it} is assumed to consist of a permanent firm-specific element κ_i and a transitory component η_{it}. The latter term follows a first-order autoregressive process, $\eta_{it} = \rho \eta_{it-1} + v_{it}$, so that

$$(4.6) \qquad \varepsilon_{it} = \kappa_i + \eta_{it}.$$

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[40] This is the simplest way of introducing sunk costs. Alternatively, it can be assumed that current profits are also affected by the status of internationalisation from periods prior to the immediately preceding interval (cf. Roberts and Tybout 1997), or we can introduce exit costs from the foreign market. The basic argumentation, however, remains unchanged.

Beside Roberts and Tybout's model, there are only a few approaches in the economics literature to modelling the export behaviour of individual firms. One alternative approach has been developed by Lautanen (2000). He interpreted entry into a foreign market as an innovation adopted by a firm. At least for small firms, Lautanen argued, it is possible to draw analogies between the adoption process of a new technology and exporting. Both processes are associated with uncertainty, they involve learning behaviour, and both are (or can be) initiated through personal contact-related stimuli. Lautanen's two-period model, therefore, consists of two parts. In the first part, the diffusion of information about international business activities is modelled as an epidemic learning process similar to technology diffusion.[41] The diffusion of information determines which firms become interested in exporting in each period. The second part explains which firms finally commit to exporting, conditional on becoming interested in exporting in the first stage of the model.

More concretely, taken the share of firms that were interested in exporting in period 1 (s_1) and the share of firms that actually exported in period 1 (e_1) as given, the diffusion of information about exporting from period 1 to period 2 follows an epidemic learning process so that the share of firms interested in exporting in period 2 is determined by

(4.7) $\quad s_2 = s_1 + d + g \cdot (1 - s_1) \cdot (e_1)$,

with d representing exogenous learning between the two periods of the model and g capturing the effectiveness of the learning process. This formula shows that the share of firms interested in exports in period 2 (s_2) is composed of three elements: firstly, the share of firms that were already interested in exporting in period 1; secondly, the share of firms that have been stimulated exogenously (i.e., without contact to other exporters of the same product); thirdly, those firms that have been stimulated by other firms. These are represented by the product of former exporters[42] and of those that were not interested in exports in period 1, multiplied with the parameter of effectiveness g.

Given that a firm is interested in exporting, the decision on committing to exporting in period 1 is represented by three equations. The first equation is the profitability condition, stating that a firm will only export if it receives non-negative (expected) profits from its export activity. Taking the same notation as for the model of Roberts and Tybout, the profitability condition in period 1 is given by:

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[41] Models of technology diffusion, among them epidemic learning models and rank, stock, and order effect models are described in detail in Stoneman (1983) and Karshenas and Stoneman (1993).

[42] In this model, the decision to internationalise is irreversible and exit is not considered.

$$(4.8) \qquad \Pi_1(Z_i) = E_1\left(\pi_1(Z_i) + \delta^{-1}\pi_2(Z_i) - N_1\right) \geq 0,$$

where Π_1 is the expected profit if the firms enters the foreign market in period 1. As before, it depends on a set of firm-specific variables Z_i.

The second equation is the arbitrage condition. A firm will commit to exporting in period 1 only if it is not profitable to wait until period 2 before entering the foreign market, that is, if the arbitrage profit a from postponing exports is non-positive:

$$(4.9) \qquad a(Z_i) = \delta^{-1}\Pi_2(Z_i) - \Pi_1(Z_i) \leq 0.$$

Finally, the third equation is a feasibility condition that demands that the firm has enough resources W for its planned export activities:

$$(4.10) \qquad W_1 \geq 0.$$

If the firm does not have export activities in period 1, either because one of the three conditions above was not satisfied or because the firm was not interested in exporting, the two conditions of entering the foreign market in period 2 are simply $\Pi_2(Z_i) \geq 0$ and $W_2 \geq 0$ – provided that the firm is interested in exporting in period 2 according to equation (4.7).

Since the data set used for this study's empirical analysis does not contain information on the stimulus that leads to international business activities, the first part of Lautanen's model cannot be tested empirically. However, the second part of the model shows some parallels to the model of Roberts and Tybout. In both models, firms will enter the foreign market if a profitability condition is met. The models contain an option of waiting, whereas, in contrast to the model of Lautanen, the Roberts and Tybout model explicitly traces a possible delay of entry (and exit) back to the existence of sunk costs. Finally, firms' internationalisation behaviour in both theories depends on the availability of firm-specific resources. Hence empirically analysing firm-specific variables that determine the export activities of high-tech firms, as it is the purpose of this study, is consistent with both models.

Theories of International Management

In order to identify variables that can be expected to discriminate between exporters and non-exporters, it is helpful to fall back on theories of internationalisation from the field of international management. One of the most influential theories is the internationalisation process model developed by Johanson and Vahlne (1977, 1990). They regard internationalisation as a gradual process

in which firms incrementally increase their commitment in foreign markets. A commitment is always associated with uncertainty. The firm extends its international business activities until its particular maximum tolerable risk is reached. This is a function of the degree of the firm's risk aversion and resource position. The commitment of resources to a foreign market increases knowledge of that market and thus reduces any existing uncertainty about the foreign environment. The internationalisation process is therefore combined with a dynamic learning process over time. An initial involvement in a foreign market reduces uncertainty, which in turn induces an additional commitment to this market. As a consequence, firms start their international activities with relatively few resources because the commitment of these resources is associated with a relatively high level of risk. Improved knowledge acquired over time through additional commitment to the market leads to more resource-intensive international activities, since the latter become associated with less risk than the firm's initial foreign activities.

The internationalisation process model is the basis of the so-called "stage" models of internationalisation (e.g., Bilkey and Tesar 1977, Bilkey 1978). In these theories the internationalisation behaviour of a firm is linked with different stages of the firm's life cycle. According to this model, a firm goes through the following stages: (i) no regular exports; (ii) exports via an intermediary; (iii) foreign sales subsidiary; (iv) foreign direct investment and foreign production. Hence, the stage models try to explain not only the entry into a foreign market per se, but also the choice of the optimal market sales mode used at different stages of the firm's international involvement.

The most important criticism of the internationalisation process model and especially of stage theories is the quasi-deterministic character of the models (Reid 1983). The argument is that firms can and will decide on an optimal sales mode and on expansion of their international activities contingent on market conditions. There is no need to proceed in the incremental way described by the model. Johanson and Vahlne have themselves already listed three exceptions where firms are likely to deviate from the gradually expanding commitment predicted by their model. Firstly, large firms may have enough resources to take larger, i.e. more resource-intensive, steps in their internationalisation process. Secondly, relevant knowledge that reduces uncertainty in a foreign market can be acquired by means other than one's own experience, for example by employing an internationally experienced manager. Finally, if market conditions in different foreign markets are homogenous, firms may generalise experience gained in one market to make larger internationalisation steps in another.

The criticism of the process model's quasi-deterministic character has more recently led to theories that combine the research paths of international business and entrepreneurship. McDougall and

Oviatt (2000, p. 903) define international entrepreneurship as "a combination of innovative, pro-active, and risk-seeking behaviour that crosses national borders and is intended to create value in organisations". The key idea of international entrepreneurship is that the availability of resources alone is not enough to initiate an internationalisation process (Andersson 2000). Action on the part of an entrepreneur is needed to trigger the internationalisation process. Entrepreneurs make strategic choices that determine the optimal method of internationalisation conditional on their firm's resources and their own capabilities and preferences. The entrepreneurial perspective, however, is not restricted to firm founders. Entrepreneurial behaviour in large companies, often called "intrapreneurship", is also covered by this concept.

The inclusion of entrepreneurship research allows us to trace different patterns of the internationalisation processes of firms back to characteristics of the entrepreneurs. Based on a case study analysis of Swedish firms, Andersson (2000) identified three different types of entrepreneurs. The technical entrepreneur is mainly interested in technology and the development of the production process. In this case, an unsolicited order from abroad may lead to exports ("pull strategy"). On the contrary, the marketing entrepreneur pro-actively creates his firm's internationalisation process ("push strategy"). He creates new channels to reach foreign customers and is willing to invest a relatively large amount of resources in order to penetrate the foreign market quickly. The third type of entrepreneurs Andersson calls "structural" entrepreneurs. This concept is relevant for large companies and mature industries, and thus less important for the sample of NTBFs examined by this study. Structural entrepreneurs regard internationalisation as but one part of their overall strategy. They organise and restructure (large) firms and, in this context, create an international business strategy, for example by choosing mergers and acquisitions as a method of entry.

The concept of international entrepreneurship as well as Johanson and Vahlne's model emphasise the role of intangible resources like experience or entrepreneurial capabilities in the internationalisation process. This is also a main topic when discussing the resource-based view (RBV) of a firm (e.g., Penrose 1959, Wernerfelt 1984) and the more recent theories that regard organisational capabilities of firms as determinants of their outcome (e.g., Teece et al. 1997, Madhok 1997). RBV models analyse how resources are accumulated and deployed by firms. A firm is interpreted as an idiosyncratic bundle of assets (physical resources as well as intangible resources like know-how, experience or tacit knowledge). Since physical assets are relatively easily obtained or imitated, a firm differentiates itself from its rivals by the intangible resources it possesses. These determine how efficiently physical assets can be used and are therefore vital to the firm's performance. With respect to the internationalisation process, this means that the costs of market entry can be reduced if intangible resources lead to a more efficient use of the firm's physical resources.

Although RBV models offer a valuable perspective on how intangible and physical resources interact, the theory remains vague in many respects. For example, it does not derive hypotheses about causalities between specific assets and firm performance. In our context, RBV models do not explain the timing of entry into a foreign market. Nevertheless, RBV models can help us deal with the peculiarities of the internationalisation process of firms that are small, young, and belong to a high-tech sector. A resource-based perspective seems to be particularly relevant for samples of NTBFs similar to the one chosen for this study. Indeed, general variables like size and age probably cannot discriminate between exporters and non-exporters since nearly all selected firms are of similar age and size.[43]

Based on the RBV, Madhok (1997) developed an organisational capability (OC) perspective of a firm's choice of its appropriate sales mode when entering into the foreign market. Madhok proposed that a firm's entry mode depends on the nature of the resource advantage a firm possesses. If a firm's advantage is inimitable and difficult to transfer to other firms like an intermediary without loss in value (e.g., tacit knowledge), the exporter will prefer a high level of control over transactions (hierarchical structure, internalisation). In contrast, if the firm's routines and strategies (i.e., its particular way of doing business) are highly specific and thus difficult to transfer to a foreign environment without loss in value, use of an intermediary will be the favoured sales mode. Madhok called this the "locational effect" (Madhok 1997, p. 48).

Thus, the internationalisation process model and the OC framework both emphasise the role of the firm's intangible assets (in particular, experiential knowledge) in its choice of the optimal entry mode. However, whereas the former theory only distinguishes between different entry modes according to the level of resource commitment, the OC framework differentiates by the level of control, i.e., whether transactions are carried out internally or whether a third partner, an intermediary, is involved.[44]

In contrast to theoretical approaches that concentrate on firm-specific resources, the transaction cost analysis (TCA) theory regards a firm as a governance structure (Williamson 1985). A transaction is conducted internally if the costs of an economic exchange in a market exceed those of a transaction within the organisational structure of a firm. The TCA theory assumes bounded rationality and opportunistic behaviour on the part of decision-makers. However, the unit of analysis is

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[43]   Oviatt and McDougall (1994), for example, regard new technology-based firms that internationalise quickly as firms with an intangible, knowledge-based competitive advantage. This perspective is consistent with the resource-based view of the firm.

[44]   As usual in the related literature, this study assumes that the concepts of control and internalisation/integration are closely related (Andersen 1997).

not the decision-maker itself, but the individual transaction. According to the TCA theory, the optimal foreign market entry mode is chosen by minimising the transaction costs. Anderson and Gatignon (1986) described the entry mode choice as a trade-off between control (the benefit of internalisation) and the costs of resource commitment (the costs of internalisation) under conditions of risk and uncertainty. The authors derived several propositions of how transaction-specific assets may influence the desired level of control. A high level of control will be preferred if a firm's product is technically sophisticated (i.e., it incorporates a higher proprietary knowledge), is unstructured and poorly understood, requires intense product customisation, or can be classified as an immature product. Novel technology that is incorporated into a (new) product is often not yet codified and therefore difficult to transmit to an intermediary. Thus, direct exporting is preferable. Intense product customisation demands close contact to customers, leading to a high reliance of the decision-maker (i.e., the domestic firm) on these working relationships with its key customers. It is proposed that the domestic firm is interested in controlling these important relationships.[45]

In addition to transaction-specific assets, Anderson and Gatignon hypothesised how external and internal uncertainty affect the entry mode decision. External uncertainty is related to a firm's environment and is typically labelled "country risk" (e.g., political instability, economic fluctuations). Anderson and Gatignon argued that in the absence of transaction-specific assets, a low-control entry mode is appropriate. The domestic firms are able to retain flexibility and shift country risk to their foreign partners, since the latter can easily be replaced if the outcome is unsatisfactory. If, however, transaction-specific assets, as described above, are prevalent, switching between different foreign partners is expensive, making a partner almost irreplaceable. These difficulties in selling a technically sophisticated product abroad are intensified in an uncertain environment. As a result, Anderson and Gatignon hypothesised that the *combination* of transaction-specific assets and external uncertainty leads to a higher degree of control. Internal uncertainty describes the lack of experience in international business activities firm managers might perceive. Moreover, internal uncertainty increases with the sociocultural distance between its domestic market and the foreign market entered by the firm. A low-control entry mode, an intermediary for instance, will be preferred if internal uncertainty prevails.[46] [47]

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[45] Technically sophisticated products also impede the monitoring of foreign distributors and agents. In this case, accurate measures of distributors' performance might not be available. Thus, we have a classic principle-agent situation, where problems like adverse selection and/or moral hazard might occur (see, e.g., Zacharakis 1997).

[46] Anderson and Gatignon (1986) further proposed that a high-control entry mode will be more efficient the higher the intermediary's free-riding potential. If the domestic firm possesses a high-value brand name, the foreign partner can "free ride" on the international recognition of the domestic firm, realising a high turnover without making its own sales efforts. Therefore, the domestic firm might prefer a high level of control in order to shield their

The main limitation of the TCA theory is that firms do not only evaluate the benefits of internalisation in terms of the reduction of transaction costs. Other considerations, like the desired market penetration in a foreign market, might be relevant as well. If these motives are taken into account firms will arrive at different entry mode choices (Andersen 1997, Madhok 1997).

Dunning's Eclectic Paradigm

The eclectic paradigm developed by Dunning (1993) is a multitheoretical framework that combines elements of all the theories already presented in this section. Dunning argues that the success of firms' international business activities depends on three factors: ownership advantages (O), locational advantages (L), and internalisation advantages (I). Dunning's eclectic paradigm is therefore also called the OLI framework. Ownership advantages are firm-specific assets and skills. They comprise experiential knowledge and other intangible assets by which a firm differentiates from its rivals according to the resource-based view of a firm and the internationalisation process model. They further include the firm's size and its physical and financial resources, which enable larger firms to take more resource-intensive steps in the internationalisation process according to Johanson and Vahlne (1990). Locational advantages describe the attractiveness of a foreign country. They include the foreign market potential as well as country risk, which was called external uncertainty by Anderson and Gatignon (1986) in their TCA model. Finally, internalisation advantages reflect the firm's ability to conduct a transaction within its hierarchical organisation efficiently, for example because of efficient control procedures. Thus, internalisation advantages are closely linked to the TCA theory.

Dunning's eclectic paradigm predicts that a firm will choose the status of internationalisation (for the firms in our sample: exporter versus non-exporter) and the entry mode (in our case: direct exports versus exporting via an intermediary) most suited to the "advantages" it possesses. The main improvement of the eclectic paradigm in comparison with other theories is that it includes a large set of explanatory variables and, most importantly, that it points out how different influenc-

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brand name from degradation by free-riders. However, the domestic, i.e. German and UK-based, firms of this study's sample are young and small. They do not (yet) possess an internationally recognised brand name. Quite the opposite applies: If the firms of our sample decide on an intermediary for entering a foreign market they might be interested in profiting from the recognition of the chosen distributor in that market.

47 Nakamura and Xie (1998) developed a model of ownership structure for technology-oriented manufacturing firms' foreign direct investment (FDI). Due to the high-tech firms' intangible assets (e.g., novel technology that is not fully contractible) full ownership, i.e., a high level of control, is the first best solution as proposed by Anderson and Gatignon (1986). If, however, selling a firm's product in a foreign country requires transaction-specific assets that only a local partner possesses (e.g., familiarity with local business practices), the investing firm will choose a joint venture with a local firm as a second-best solution. This corresponds to Anderson and Gatignon's effect of internal uncertainty.

ing factors interact. For example, a firm that generates an intangible asset by carrying out intense R&D activities so that its product incorporates novel, self-developed technology (the firm's ownership advantage) only chooses an integrated entry mode if it is also able to organise the distribution of its product abroad efficiently (the firm's internalisation advantage). However, the large set of explanatory variables is also the eclectic paradigm's greatest weakness. If every imaginable variable is included in a theory it is difficult to derive testable hypotheses (Andersen 1997). Itaki (1991) claimed that a detailed eclectic paradigm becomes virtually tautological. According to Dunning (1993) himself, the eclectic paradigm intends to explain "what is" rather than, in the normative sense, "what should be" the level and structure of a firm's internationalisation behaviour.[48]

4.2   Foreign Market Entry and Exit

The focus of this section is the long-term internationalisation behaviour of the firms surveyed. An advantage of our unique data set is that in contrast to most other studies, it contains a large set of explanatory, firm-specific variables (e.g., R&D activities, characteristics of a firm's best-selling product or service, managerial profile) motivated by the literature of international management and observed over time. Thus, it is possible to identify "hard" success factors that are linked with long-term export activities.

Studying long-term export behaviour cannot be restricted to the analysis of foreign market entry. Although there is a high persistence in export behaviour, we observe market entry and exit in our data set. Just under 13 % of firms that recorded international sales in 1997 had left the foreign market by 2003 (see section 4.2.2 for more details). This observation is in line with other empirical studies that have examined long-term international business activities (see, e.g., Roberts and Tybout 1997, Bernard and Jensen 2004). In this section, I will empirically analyse entry into and exit from the foreign market by applying logit models that firstly explain the transition from the internationalisation status "non-exporter" to that of "exporter", i.e. foreign market entry, and secondly the transition from the internationalisation status "exporter" to that of "exporter", i.e. remaining internationally active. Of course, by trivial recoding, the second model explains exit from the foreign market. I will begin, however, with a short review of empirical studies that have examined firms' long-term internationalisation behaviour.

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[48]   If, in the normative sense, the OLI framework gave advice to firm managers as to what they should do, selecting foreign entry mode based on the firm-specific OLI advantages should lead to better performance than that of firms that do not match their entry mode choice to their OLI advantages. Brouthers et al. (1999) found empirical support for the OLI framework as both a descriptive and a normative model.

4.2.1 Literature Review

Most empirical studies that have analysed firms' long-term export behaviour go back to the dynamic model of Roberts and Tybout (1997) that was presented in the previous section. Using a data set of Colombian plants in the manufacturing sector observed between 1981 and 1989, inclusive, Roberts and Tybout (1997) themselves estimated their binary-choice model (4.5) by applying a random effects probit model. As a major result of their analysis, they discovered that sunk costs are relevant. If a firm had exported in the previous year, the probability of it being international in the current period would increase by 63 %. However, the effect of previous international activities has been shown to depreciate rapidly. After a two-year absence from the foreign market, re-entry costs are no longer different from the costs faced by firms entering the international market for the first time. Apart from the effect of sunk costs, Roberts and Tybout confirmed that observed and unobserved plant characteristics have a significant influence on the firms' export behaviour. The probability of internationalising increases with firm size, age, and a dummy variable that indicates whether the plant is owned by a corporation.

Bernard and Jensen (2004) used data collected on U.S. manufacturing plants between 1984 and 1992 to estimate the same model as Roberts and Tybout. They confirmed the relevance of both sunk costs and plant-specific variables in the plants' export behaviour. Applying a random effects probit model, the probability of a plant exporting in a certain year would increase by 62 % if the plant had exported in the previous year. The measure of the effect of the lagged export status, however, depends on the econometric method applied. Using a linear probability model with fixed effects, the marginal effect of the lagged internationalisation status drops substantially to 20 %.[49] Moreover, the observed plant-specific characteristics size, productivity, and share of white collar workers are significantly positively correlated with exporting. Using data from German manufacturing plants in Lower Saxony, Bernard and Wagner (2001) get similar results for the effect of sunk costs. The lagged export status increases the probability of exporting today by 38 % (linear probability fixed effects model), or 68 % (random effects probit model) respectively.

All of the aforementioned studies examined samples of large and mature manufacturing firms. However, it is questionable whether these studies' results are transferable to a sample of newly founded technology-based manufacturing and service firms. There are numerous studies that have investigated the internationalisation processes of NTBFs during their start-up period (e.g.,

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[49]   Bernard and Jensen (2004) provided a detailed discussion of the role of different econometric methods when estimating the binary choice framework given in equation (4.5). They stressed that the fixed effects estimator in a linear probability model is almost certainly biased downward but gives a lower bound of the effect of previous export status.

Lindqvist 1991, McDougall et al. 1994, Bürgel et al. 2004). However, to the best of my knowledge, no other study has been performed that observes NTBFs over a relatively long time period, investigating long-term internationalisation behaviour. This study will try to address this disparity by empirically examining the long-term export activities of our sample of young German and British technology-oriented firms.

4.2.2 Descriptive Analysis

Comparing the firms in our sample with and without international business activities, significant differences in some key firm-specific characteristics become evident (see Table 4-1). On average, 26 employees worked in the sampled firms in 2003. Considering only those firms that participated in both surveys, the average number of employees had increased by an average of 7 employees (or 37 %) since 1997. The 1997 and 2003 surveys both reveal a higher mean value (and a higher median, not shown here) of number of employees for firms with exports compared with non-exporting firms. Applying a t-test proves that total employment of exporting firms significantly exceeds that of firms with only domestic sales in both Germany and the UK. Regarding firm age (measured in years), the firms in our sample were an average of 12 years old in 2003. The mean of firm age is always higher for exporting firms. However, based on a t-test the differences are not significant.

Table 4-1: Comparison of Means between Exporters and Non-Exporters

| | Germany | | | UK | | |
| | International sales | | | International sales | | |
	No	Yes	t-test	No	Yes	t-test
1997						
Number of employees	11.57	18.85	***	14.80	22.87	*
Firm age (in years)	5.20	6.03		7.03	7.40	
R&D intensity (in %) [a]	17.83	16.15		9.73	15.68	
2003						
Number of employees	15.04	32.37	**	18.57	28.19	*
Firm age (in years)	11.44	11.91		13.11	13.29	
R&D intensity (in %) [a]	3.40	14.67	***	5.36	16.58	***

[a] Expenditures on R&D as percentage of sales.

* 10 % level of significance; ** 5 % level of significance; *** 1 % level of significance.

Note: Only firms that participated in both surveys were considered.

Source: ZEW, University of Exeter, own calculations.

In 1997, German and UK-based technology-oriented firms spent an average of 15.4 % of their total sales on research and development. Neither in Germany nor in the UK is the mean of R&D intensity of exporting firms significantly different from the respective value of non-exporting firms, although it should be noted that for the UK this is the result of a high standard error. In 2003, R&D intensity decreased by two and a half percentage points to an average of 12.8 %. This is not necessarily a result of falling expenditures on R&D. It may also be attributed to rising sales. During the early stage period covered by the 1997 survey, many high-tech firms incur high costs developing new products or services that can be commercialised. On the other hand, total sales might be relatively modest until the firm becomes established in the market. Therefore, R&D intensity can be expected to be higher during an early stage of a high-tech firm's life cycle than in a later stage, making the declining mean R&D intensity between 1997 and 2003 less surprising. It is, however, remarkable that the drop in R&D intensity has been caused mainly by non-exporting firms, whereas the average R&D intensity of exporters has changed only slightly. As a consequence in 2003, the mean R&D intensity of firms with international sales is significantly higher than the mean of non-exporting firms. In fact, among those firms that have never had international sales (see Table 4-3 and the explanations below) three-quarters did not carry out any own R&D activities in 2003.

Table 4-2 shows the share of firms with and without international sales in 1997 and 2003, respectively, again considering only those firms that participated in both surveys. In both countries, more than two-thirds of responding firms had international sales. Even the majority of firms from the service sector (mainly software firms) turned out to have international business activities, although the percentage of firms with international sales is smaller than in any aggregated high-tech manufacturing sector. In the manufacturing industry, firms that belong to the sectors ICT-hardware, engineering, and health/life sciences export their products more often than other manufacturing firms. In the UK-based sample, all firms in the sectors ICT-hardware and health/life sciences even have international business activities. However, it should be mentioned that the number of observations in these two sectors is rather small. In Germany, only 5 ICT-hardware firms (15 firms in health/life sciences) answered both surveys; in the UK there are 12 ICT-hardware firms (10 in health/life sciences).[50]

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[50] Recall that in contrast to the first survey where no sector bias was found, the ICT-hardware sector is underrepresented in the German as well as in the UK-based sample. Conversely, the health/life sciences sector (engineering sector) is overrepresented in the German (UK-based) sample (cf. chapter 3).

Table 4-2: Firms with International Sales, by High-Tech Sector (in %)

| | Germany | | | | UK | | | |
| | 1997 | | 2003 | | 1997 | | 2003 | |
Sector	No	Yes	No	Yes	No	Yes	No	Yes
Software/services	50.0	50.0	45.5	54.5	40.6	59.4	35.5	64.5
ICT-hardware	20.0	80.0	20.0	80.0	0.0	100	0.0	100
Engineering	15.8	84.2	10.5	89.5	20.0	80.0	13.8	86.2
Health/life sciences	20.0	80.0	20.0	80.0	0.0	100	0.0	100
Other high-tech manuf.	27.3	72.7	27.3	72.7	25.7	74.3	31.4	68.6
Total	31.6	68.4	28.7	71.3	23.5	76.5	22.2	77.8

Note: Only firms that participated in both surveys were considered.

Source: ZEW, University of Exeter, own calculations.

When calculating the percentages of firms with foreign sales for the complete cross section of the 1997 survey, the percentages turn out to be generally smaller compared with the respective values of the firms that participated in both surveys, those considered in Table 4-2. As already discussed in section 3.3, there are two possible selection processes that can lead to this result. Firstly, firms that answered the second survey may have behaved differently compared with the complete target sample from the 2003 survey (non-response bias). Since we did not carry out a non-response analysis, we do not know whether there are differences between respondents and non-respondents in 2003, but the relatively high response rate is an indication that this interpretation is not very likely. Secondly, the firms still currently living may have behaved differently in 1997 compared with the period's general cross section, i.e., including those firms that had already dissolved between the two surveys (survival bias). The higher percentage of internationally active firms in 1997 among those that survived the following six years may serve as an indication of a positive correlation between internationalisation and firm survival. This needs further research but is beyond the scope of this study.[51]

As Table 4-2 further shows, there was a slight increase in the firms' international engagement between 1997 and 2003 in all sectors, with the exception of other manufacturing firms in the UK. Apart from this sector, the share of firms with exports in 2003 was at least as high as in 1997. These numbers, however, do not allow us to see how many firms had entered the foreign market for the first time since 1997 and how many firms had left the market. Roberts and Tybout (1997) already showed that although there is a high persistence in the individual firm's status of interna-

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[51] The effect of internationalisation on firm survival has been examined empirically, for example, by Bernard and Jensen (1999).

tionalisation due to sunk costs, quite a high number of firms change internationalisation status, leading to entry and exit over time. The development of internationalisation status of the sampled firms is listed in Table 4-3. This table also includes a separate column for the time of start-up. A firm is defined as having international sales during its start-up period if it entered its first foreign market no later than one year after firm formation. These firms are called "infant multinationals" (Lindqvist 1991) or "born globals" (McKinsey 1993a).

Table 4-3: Development of Internationalisation Status

Foreign sales (yes=1)			Germany		UK	
Start-up	1997	2003	%	n	%	n
1	1	1	27.7	26	25.0	29
1	1	0	3.2	3	0.9	1
1	0	1	0.0	0	0.9	1
0	1	1	30.9	29	45.7	53
1	0	0	0.0	0	0.0	0
0	1	0	8.5	8	6.9	8
0	0	1	13.8	13	6.9	8
0	0	0	16.0	15	13.8	16
Total			100	94	100	116

Source: ZEW, University of Exeter, own calculations.

About a quarter of all firms had international sales shortly after their formation. Further, just under 31 % of the German firms and 46 % of the firms in the UK did not export during their start-up period, but were internationally active when the two surveys were conducted. On the other hand, 16 % of German and almost 14 % of UK firms never had any international sales. More interesting for the purpose of this section are the firms that have changed their status of internationalisation. Ignoring the firms' behaviour at time of start-up for the moment, nearly 12 % of German and 8 % of UK-based firms left the international market between 1997 and 2003. During the same period, 14 % of German firms and 8 % of firms sited in the UK entered the international market. Thus, German high-tech firms more frequently change their status of internationalisation, whereas UK firms show a higher persistence in their internationalisation behaviour.

The analysis of the development of the internationalisation status in this section has, however, one shortcoming: We can only determine the status in the two years 1997 and 2003. We do not know whether firms had foreign sales in each year or whether they left the foreign market for a couple of years and re-entered just before the second survey was conducted. In other words, we do not have annual information on the firms' export status trajectories.

4.2.3 Econometric Implementation

This section concentrates on foreign market entry and exit. Since the firms have been observed only twice, dynamic probit models, as used by Roberts and Tybout (1997) or Bernard and Jensen (2004) (see section 4.2.1), are not suitable for our data set. Strong restrictions would have to be imposed to identify the model (cf. Honoré and Kyriazidou 2000). Instead, I estimate the probability of a transition from one status of internationalisation to another or the same status in the next period. I apply a model inspired by Gouriéroux (2000) and used by Van et al. (2004) in order to estimate the transitions between different states of firm performance of German service firms.

As before, let Y_{it} denote the status of internationalisation j in which firm i is in time t, with $Y_{it} = 1$ if firm i exports in time t and $Y_{it} = 0$ otherwise. The transition probabilities are modelled with the logistic formulation and depend on a set of explanatory variables. The probability of transition of firm i from status j in t-1 to status j' at time t is then given by

$$(4.11) \quad \mathrm{Pr}_{ijj'}(t) \equiv \mathrm{Pr}\left(Y_{it} = j' \middle| Y_{it-1} = j\right) = \frac{\exp\left(x_{it}\beta_{jj'}\right)}{\sum_{j'=0}^{1} \exp\left(x_{it}\beta_{jj'}\right)},$$

$i = 1, \dots, N$, $t = 0, 1, 2$, and $j, j' = 0, 1$.

Imposing the identifying restriction $\beta_{j0} = 0$, we obtain

$$(4.12) \quad \mathrm{Pr}_{ij0}(t) = \frac{1}{1 + \exp\left(x_{it}\beta_{j1}\right)},$$

$$(4.13) \quad \mathrm{Pr}_{ij1}(t) = \frac{\exp\left(x_{it}\beta_{j1}\right)}{1 + \exp\left(x_{it}\beta_{j1}\right)},$$

with $j = 0, 1$. Thus, a logit model is specified for each row of the transition matrix. Let us define $n_{i,t-1,t}(jj') = 1$ if firm i occupies status j in t-1 and status j' at time t, and 0 otherwise. Then the log-likelihood conditional on the status occupied at time t-1 is

$$(4.14) \quad \ln L = \sum_{j=0}^{1}\sum_{j'=0}^{1} \ln L_{jj'}, \quad \text{with} \quad \ln L_{jj'} = \sum_{i=1}^{N}\sum_{t=1}^{2} n_{i,t-1,t}(jj') \ln \mathrm{Pr}_{ijj'}(t).^{52}$$

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[52] It is important to note that the dependent variable is the transition probability and not the individual firm. Provided that there are no missing values for the independent variables, a single firm will enter the log-likelihood function twice: with the transition probability from the start-up period to 1997 and with the transition from 1997 to 2003.

Since the quantity $\sum_{j'=0}^{1} \ln L_{jj'}$ only depends on β_{j1}, the maximum likelihood estimators $\hat{\beta}_{j1}$ can be obtained by individually maximising the elements of $\sum_{j'=0}^{1} \ln L_{jj'}$, $j = 0, 1$.[53]

In order to discriminate between firms that have entered the international market and firms that stay absent from it, I estimate a conventional logit model. Regarding the second element of the log-likelihood function, where I distinguish between firms that continued to have international sales and firms that left the international market between the two observed points in time, the problem emerges that an exit from the foreign market is rare compared with the event of staying internationally active. Based on McCullagh and Nelder (1989), King and Zeng (2001) showed that in rare events data in finite samples, the maximum likelihood estimator $\hat{\beta}$ is biased and that the bias is amplified the smaller the proportion of the rare event. Moreover, the estimated probability of the rare event – in our case, the estimated probability of exit from the foreign market $\widehat{\Pr}_{i10}$ – is too small, and hence the probability of the more frequent event, i.e., the probability of staying in the international market $\widehat{\Pr}_{i11}$, is overestimated.

King and Zeng (2001) showed that the bias of $\hat{\beta}$ can be calculated applying a weighted least-squares estimation, thereby leading to a bias-corrected estimate of β, denoted $\tilde{\beta}$. Furthermore, King and Zeng derived an analytical approximation for estimating the probability $\Pr_{i11}$ as

$$(4.15) \quad \Pr_{i11} \approx \frac{1}{1 + \exp\left(x_i \tilde{\beta}_{11}\right)} + C_i = \widetilde{\Pr}_{i11} + C_i,$$

where the correction factor is

$$(4.16) \quad C_i = \left(0.5 - \widetilde{\Pr}_{i11}\right)\widetilde{\Pr}_{i11}\left(1 - \widetilde{\Pr}_{i11}\right)x_i \, Var\left(\tilde{\beta}_{11}\right)x_i'.\text{[54]}$$

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[53]   I have also extended this model by allowing for the possibility of random effects, one for each firm and for each type of transition as proposed by Van et al. (2004). The linear index that the transition probabilities depend on now becomes $x_{it}\beta_{jj'} + \sigma_{jj'}u_{ijj'}$. The terms $\sigma_{jj'}u_{ijj'}$ are assumed to be mutually independent and independent of x, with mean 0 and variance $\sigma_{jj'}^2$. The random variable $u_{ijj'}$ has been assumed to be standard normal distributed. The parameters $\sigma_{jj'}$ have to be estimated. This model has been estimated by simulated maximum likelihood. However, a likelihood ratio test of the restricted model (i.e., with all $\sigma_{jj'}$ set to 0) against the unrestricted model cannot reject the null hypothesis (LR $\chi^2(4) = 2.836$; [Prob $> \chi^2$] =0.586). Apparently, the large set of firm-specific variables in my estimation equation (see below) is able to discriminate between exporters and non-exporters, i.e., a large part of firm-specific heterogeneity is, in fact, observed. Therefore, in the following I will restrict my analysis to a model without simulated heterogeneity.

[54]   For simplicity, I have neglected the time subscript t in this formula.

The estimator $\widetilde{\Pr}_{i11} + C_i$, which is called an approximate Bayesian estimator, is not unbiased but it is superior in the sense that it has a smaller mean square error than other estimators of $\Pr_{i11}$ (see King and Zeng 2001). Therefore, I use this rare event logit model to estimate the second element of the log-likelihood function in equation (4.14).

The vector of explanatory variables x_{it} may contain both firm-specific variables, denoted Z_{it} in equation (4.5), and variables exogenous to the firm, denoted X_{it}. According to the trade theories the dynamic model of Roberts and Tybout (1997) is based on (cf. Baldwin and Krugman 1989, Krugman 1989), exchange rates are supposed to play a crucial role in influencing a firm's decision to export. To determine the effect of an exchange rate movement, I constructed weighted real exchange rate indices for the euro (Deutsche Mark) and the British pound for each of the five high-tech sectors.[55] The weights are defined by the share of exports of each respective industry to that industry's ten most important export countries as revealed by the 1997 survey, computed separately for German and UK firms. Calculating exchange rate indices in this way, we are essentially able to estimate the reaction of (potential) exporters to changes in prices on the industry's most important foreign markets (cf. Bernard and Jensen 2004).

Firm-specific variables can be derived from the literature of international management. Four dimensions of firm characteristics will be considered: firm size and age, R&D activities, product characteristics, and human capital and management capabilities.

Firm size and age are important elements of the internationalisation process model and of the stage models. If a firm increases its international activities gradually as predicted by the stage models of internationalisation, it will start with no export activities and will enter its first (unknown) foreign market at a later stage of its life cycle. Therefore, I hypothesise that firm age, measured by the logarithm of firm age (in years) at time of the respective survey, is positively correlated with an arrival status (status j' at time t in equation (4.14)) "exporter". Similarly, Johanson and Vahlne (1990) state that larger firms posses more resources and are more likely to take larger internationalisation steps – independent of their age. Thus, it can be expected that firm size, measured by the logarithm of the number of employees at time of the respective survey, increases the probability of remaining an exporter or of changing internationalisation status to become an exporter at time t.

Resource-based theories emphasise that firms stand apart from their rivals by intangible resources. The latter also constitute ownership advantages according to Dunning's OLI framework. One way

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55   The data sources of nominal exchange rates and consumer price indices used to calculate real exchange rates are described in detail in appendix A.1.

to gain such firm-specific assets that are only imperfectly imitable by other firms is by conducting R&D activities and developing novel technology to produce the firm's product (cf. Bürgel et al. 2004). Firms' R&D activities are measured by the percentage of total sales spent on R&D. A higher R&D intensity should lead to a higher propensity to be engaged in international markets. Further, firms were asked to describe the innovativeness of their best-selling product or service by indicating the technology incorporated into the firm's product. In the econometric analysis, two dummy variables will be included. The first dummy takes the value 1 if, according to the representatives of the firm, the firm's product incorporates novel technology that had to be developed specifically for this product by the company itself. The second dummy variable indicates whether the firm's product incorporates novel technology that has been developed by other firms. Thus, both dummy variables represent novel technology, but only in the first case the company has to carry out own R&D activities. I assume that the use of novel technology positively affects firms' inclination to export to a foreign market, since such technology cannot easily be imitated by rival companies – at least, the novel technology has to be bought from other companies, for example, by paying a licence fee to the company which developed the novel technology.

Product characteristics may influence the internationalisation behaviour of firms. High customisation requirements may act as a constraint to entering the foreign market. They involve close contact with end-users, inducing high transaction costs prior to selling the product. Similarly, regular maintenance and the necessity of frequent upgrades lead to high transaction costs after the product has been sold (cf. Williamson [1985] for a presentation of transaction cost economics). The questionnaires used in both surveys measure the degree of customisation and necessary maintenance on a five point Likert scale ranging from 1 "unimportant" to 5 "very important". For the econometric estimations, two dummy variables will be used taking the value 1 if the firm has classified the requirements of customisation and maintenance, respectively, as "important" (4) or "very important" (5). Moreover, a dummy variable indicating whether the firm's best-selling product is sold to end-users will be included. This variable is also presumed to reduce the probability of beginning or continuing to export due to the higher communication and distribution costs involved in selling a product to end-users.

Human capital and the capabilities of the management team are highlighted by the theories of international management presented in section 4.1. As an exception to the internationalisation process model, Johanson and Vahlne (1990) mentioned the possibility that the knowledge necessary to reducing uncertainty about a foreign market can be acquired by employing an internationally experienced manager. Therefore, the firms were asked whether a member of the firm's management team had work experience abroad or whether a manager was educated abroad before

joining the company. These factors can also be regarded as constituting an intangible asset deci-sive in determining firms' internationalisation behaviour from a resource-based view of the firm and according to Dunning's OLI framework. However, not only previous experience but also and in the first line integral capabilities and skills possessed by members of the management team are likely to increase the probability of an international engagement. Therefore, the firms' representa-tives were asked to indicate on a five point Likert scale whether they experience a shortage of skills in different areas, among them sales, distribution, production, and R&D. The econometric model will include two dummy variables taking the value 1, if a firm's managers experience a "serious" (4) or a "very serious shortage" (5) of skills in sales/distribution and production/R&D, respectively. These two variables also reflect the entrepreneurial perspective developed by Andersson (2000). The absence of a serious shortage of skills in sales and distribution may indi-cate that the managers in question are behaving like marketing entrepreneurs who pro-actively create the internationalisation process for their firm. On the contrary, the absence of a shortage of skills in production or R&D may hint at the involvement of a technical entrepreneur, who is mainly interested in technology and the development of the production process.

Moreover, the econometric model will include two dummy variables that signify whether a firm is sited in Western Germany and Eastern Germany, respectively. The empirical analyses based on the cross section of the first survey revealed a significantly positive marginal effect on the Western German firms' propensity to internationalise compared with Eastern German and UK firms, whereas there was no difference between Eastern German and UK firms (see Bürgel et al. 2004). Hence, I will distinguish not only between German and UK firms but also between Western and Eastern German firms in order to reconsider the effect observed in the first survey. Finally, I will add industry dummies to the estimation equation. As Table 4-2 shows, in the manufacturing sec-tors ICT-hardware and health/life sciences almost 100 % of the firms had international sales in 1997 and 2003. Including dummy variables for each of these two manufacturing sectors will thus lead to the inclusion of variables that will almost perfectly predict the international engagement of firms in these sectors. Hence, I will include only one dummy for the engineering sector and a combined dummy variable for all remaining high-tech manufacturing industries, thus using the software/service sector as the base category.

4.2.4 Empirical Results

The results of the empirical model are given in Table 4-4.[56] The second column shows the vector of coefficients $\hat{\beta}_{01}$, explaining the transition from the status "non-exporter" at time t-1 to the status "exporter" at time t, i.e., foreign market entry. The third column includes the vector $\tilde{\beta}_{11}$, which discriminates between firms that stay in the international market (transition from status "exporter" to status "exporter") and firms that exit from the international market. Remember that the coefficient vectors β_{00} and β_{10} were set to 0 in order to identify the model.

The industry real exchange rate has no effect either on the probability of entry or on the probability of exit. This contradicts to the findings of other empirical studies (e.g., Roberts and Tybout 1997, Bernard and Jensen 2004). However, it should be noted that the firms in the sample are observed only twice with a six year interval between the two surveys. The weighted exchange rate indices, thus, take only two different values for each industry in Germany and the UK, respectively. Moreover, the calculated indices show only minor movements in the weighted real exchange rates of the euro (Deutsche Mark) and the British pound from 1997 to 2003.[57] Therefore, the results should not be interpreted as a disproof of the importance of the real exchange rate for the firms' internationalisation behaviour.

The country-specific dummy variables reveal a lower probability of East German firms entering the foreign market than both West German and UK firms. East German firms in our sample were founded shortly after German reunification. Foreign trade in former East Germany was traditionally oriented towards Eastern Europe and all East German firms have had to learn how to access Western European markets. Of course, since all firms in our sample are newly founded firms, each individual firm had to investigate potential foreign markets in order to reduce the uncertainty of its first entry – whether it is sited in East Germany, in West Germany, or in the UK. However, West German and UK firms may profit from regional spillover effects that reduce the costs of entry and do not exist in Eastern Germany. In particular, the presence of multinational firms may increase the availability of specialised capital and labour inputs, thereby facilitating foreign market entry

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[56]   The results were obtained using the statistical software package STATA, version 8.2 SE. The estimator of the rare events logit, programmed by Michael Tomz, Gary King, and Langche Zeng, is available at http://GKing.Harvard.Edu (cf. King and Zeng 2001). For analysing the results, I further used the STATA-based programme CLARIFY, written by Michael Tomz, Jason Wittenberg, and Gary King, and also available at http://GKing.Harvard.Edu (cf. King et al. 2000).

[57]   The nominal exchange rate of the euro and the pound to the most important foreign currency, the US dollar, did indeed change significantly during the period from 1997 to 2003. But in 1997, the average rate was nearly the same as the average rate in 2003.

Table 4-4: Propensities of Foreign Market Entry and Exit

	Transition non-exporter→ exporter			Transition exporter → exporter		
	Logit model			**Rare events logit**		
	Number of observations = 150 LL = -66.920 $\chi^2 (17) = 47.47$ Prob > $\chi^2 (17) = 0.000$ McFadden's R^2 = 0.317			Number of observations = 185 $\chi^2 (17) = 18.28$ Prob > $\chi^2 (17) = 0.365$ [a]		
	Coeff.	*Robust stand. error*		*Coeff.*	*Robust stand. error*	
Industry real exchange rate	-0.211	0.155		0.206	0.248	
West Germany	-0.932	0.575		1.060	1.348	
East Germany	-1.806	0.697	**	-0.202	1.425	
Engineering	0.768	0.622		1.993	0.985	**
Other manufacturing industries	1.649	0.549	***	1.209	1.018	
Log (number of employees)	1.236	0.265	***	0.570	0.323	*
Log (age)	0.643	0.572		-0.236	0.702	
R&D intensity	0.063	0.035	*	0.076	0.040	*
Novel self-developed technology	-0.376	0.538		-0.278	0.519	
Novel techn., developed elsewhere	-0.801	0.627		0.855	1.062	
Working experience abroad	0.979	0.471	**	0.569	0.766	
Education abroad	-0.748	0.794		1.854	0.922	**
Shortage of competencies						
Sales/distribution	0.308	0.530		-0.126	0.594	
Production/R&D	-1.016	0.548	*	0.126	0.710	
Intense product customisation	-1.109	0.537	**	-1.587	0.966	*
Regular maintenance and upgrades	0.032	0.450		-0.870	0.708	
Consumer good	-0.688	0.491		0.668	0.741	
Constant	17.611	14.904		-21.381	26.842	

* 10 % level of significance; ** 5 % level of significance; *** 1 % level of significance.

[a] The value of the log-likelihood function and McFadden's R² are not reported since the rare event logit is an unbiased estimator and not a likelihood technique. Thus, it does not maximise a likelihood function.

Base category: UK software/service firm with arrival status "non-exporter".

Source: own estimation.

for future exporters (Aitken et al. 1997). In Eastern Germany, multinational firms were absent at least in the first years after German reunification. On the other hand, once firms have overcome the barrier presented by foreign market entry, there is no significant difference with respect to market exit among firms from West Germany, East Germany, and the UK.[58]

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[58] Bernard and Jensen (2004) tested for geographical spillover effects in the US manufacturing industry, but did not find any evidence of the existence of spillover effects that were hypothesised to reduce entry costs. According to the authors, this may result from the exclusive selection of large manufacturing plants.

Comparing these results with the estimated propensity to internationalise from the first survey, we see that in contrast to earlier results[59], West German firms no longer have a higher probability of exporting than UK firms. Thus, when regarding a longer time period, the difference between West German and UK firms that was observed during the firms' early stages disappears.

Firms from the other manufacturing industries (including health/life sciences and ICT-hardware) are more likely to enter the foreign market than engineering and software firms. Software and service firms often offer their services locally, acting as contract developers for larger firms. The lower probability of foreign market entry by software/service firms is consistent with the descriptive statistics in Table 4-2. Surprisingly and in contrast to the descriptive analysis, engineering firms differ from the other manufacturing industries. They also have a lower probability of entering the foreign market. Possibly, there are industry-specific entry costs that are not captured by the remaining firm-specific variables. High entry costs might hamper engineering firms in starting to export. Given the earlier descriptive results showing that the share of engineering firms with international sales is comparable to that of the other manufacturing sectors, we might conclude that engineering firms are better equipped with assets that enhance their international business activities, enabling them to overcome the possibly high industry-specific entry barriers. The existence of high entry costs in engineering industries is also supported by the estimated exit probability. Engineering firms have a lower probability of exiting from the international market than all other industry sectors. If there are high entry costs, engineering firms tend to avoid these high industry-specific re-entry costs by staying in the international market. On the other hand, if re-entry costs do not vary significantly among the other industries, firms will have the same probability of leaving the international market. This includes software firms once they have entered the foreign market.

As predicted by the internationalisation process model, larger firms, measured by the logarithm of number of employees, are more likely to enter the international market. We should, however, be careful when interpreting the correlation between firms' export behaviour and firm size. The causality between exporting and performance is a matter of intense empirical discussion. A large firm size can be regarded as an outcome of good firm performance in the past. Bernard and Jensen (1999) appropriately entitled their paper "Exceptional Exporter Performance: Cause, Effect, or Both?". The result of this paper is very clear-cut: "Good plants become exporters", (Bernard and

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[59] In this section, it often seems reasonable to compare the empirical results of this study with the results of the cross-sectional analyses of the first survey. The results of the first survey are given in Bürgel et al. (2004); I will refer to this report, although I will not mention it explicitly in each case.

Jensen 1999, p. 23).[60] Taking this result as given, the empirical specification chosen in this section is correct: An above-average employment growth rate prior to the time of the survey, which typically leads to a higher observed number of employees, causes a higher probability of entering the international market. It might be suspected that the very clear result that good firms become exporters will not hold for our sample of young high-tech firms, since we observe a fairly high number of firms that have exported since start-up ("born globals"). It is simply not possible for born globals to have grown faster in the years prior to the start of their international activities as in the case of the US manufacturing firms studied by Bernard and Jensen. Thus, the estimated positive correlation between firm size and export activities in this section might reflect reverse causality or a feedback relationship between these two variables, making firm size endogenous in the above regression. The direction of causality will therefore be analysed extensively in chapter 5.

The relationship between firm size and the predicted probability of entering the foreign market is depicted by the upper left graph in Figure 4-1. Setting all other variables to their mean, the graph clearly reflects the positive correlation between number of employees and (predicted) propensity to internationalise. The graph only has a relatively steep slope where the number of employees is small. The predicted probability of entering exceeds 80 % at 17 employees. The graph becomes flat thereafter, nearly reaching a 100 % probability of starting exports for firms with more than 100 employees. If a minimum size for international business activities exists, it is quite low and already exceeded by the average firm in our sample.[61]

Firm size not only positively affects the probability of foreign market entry, it is also correlated with a higher persistence in firms' exporting activities, i.e., large firms are less likely to exit from the foreign market than small firms. This result can be interpreted in two ways: Firstly, shrinking firms may stop exporting because they no longer have enough resources to carry out international business activities. Alternatively, an exit from the international market may cause a drop in the number of employees, e.g., because firms may no longer be exposed to international competition and best practise technology, or because an exit may signal failure to domestic customers (McKinsey 1993b, Bernard and Wagner 1997). In the literature, the relationship between foreign market exit and the development of employment is practically neglected. One exception is the study of Girma et al. (2003) on UK firms. Applying matching techniques, they discovered that employment and output drop in the year of exit and in the two subsequent years, while total factor

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[60]   This result is confirmed, for example, by Bernard and Wagner (1997), Clerides et al. (1998), and Arnold and Hussinger (2005).

[61]   Recall that the average firm in our sample had 19 employees in 1997 and 26 in 2003 (see section 4.2.2).

Figure 4-1: Predicted Probability of Foreign Market Entry and Exit

Transition non-exporter→ exporter (0→1)   **Transition exporter → exporter (1→1)**

Predicted probability in dependence of
the number of employees
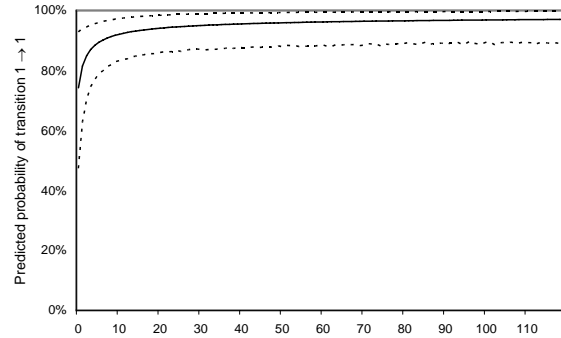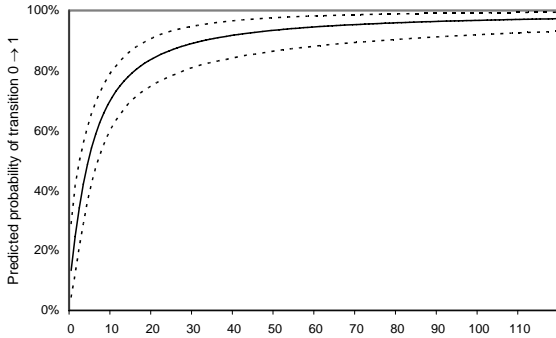
Predicted probability in dependence of
firm age (in years)
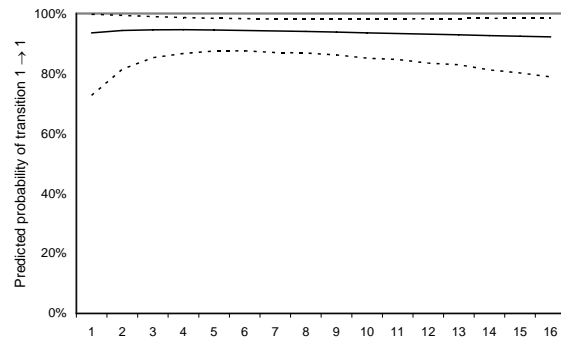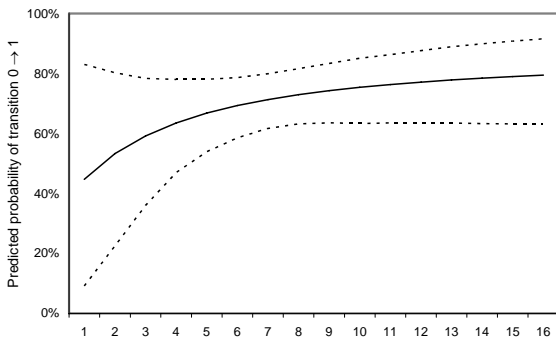
Predicted probability in dependence of
R&D intensity (in %)
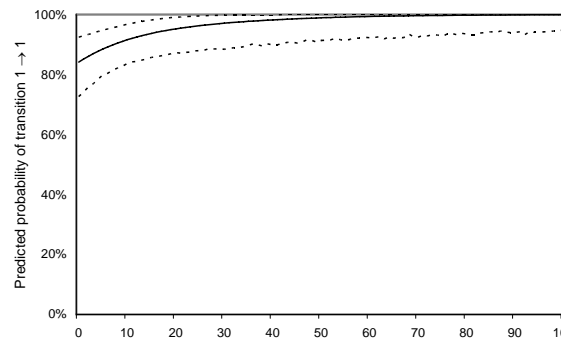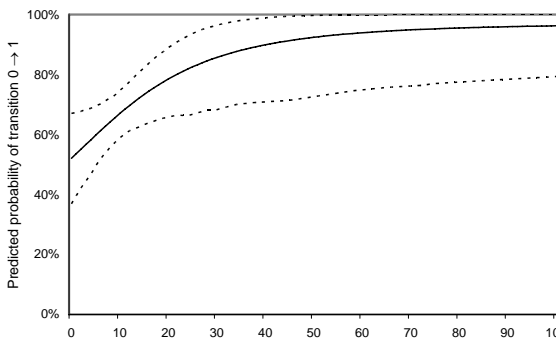
Solid line: predicted probability of transition in dependence of the continuous variable, all other variables set to their mean.
Dotted lines: simulated 90 % confidence interval, using 1,000 simulations for the transition from the status of non-exporter to the status exporter (left column) and 10,000 simulations for the transition from the status exporter to the status exporter (right column).
Source: own calculation.

productivity does not decrease after exit. For German plants, Bernard and Wagner (1997) also noted a significant drop in employment after exiting the foreign market.

The upper right graph in Figure 4-1 depicts the predicted probability of staying in the international market in dependence of the number of employees, with all other variables set to their mean. Since a market exit constitutes a rare event in our data, the predicted probability of remaining an exporter is high, in most cases exceeding 90 %.[62] The graph shows that only firms with fewer than approximately 10 employees have a significantly lower probability of continuing to exporting. Interestingly, if international business activities require a minimum size, the threshold for staying in the foreign market is even smaller than the threshold for market entry. Once the firms have paid sunk entry costs like accessing information on foreign markets or setting up foreign sales channels, operating costs in the foreign market can in general be borne even by very small firms.

Firm age has no significant effect on the transition probabilities. This result contradicts the stage models of internationalisation. Interestingly, the cross-sectional analysis of the first survey resulted in a positive influence of firm age on the propensity towards internationalisation. Obviously, when regarding a longer time period, firm age is no longer relevant, probably because the surveyed firms are now an average of 12 years old and no longer belong to what is in general defined as newly founded technology-oriented firms (see section 2.1). For "mature" high-tech firms, firm age seems unable to discriminate between exporters and non-exporters. The relationship between firm age and foreign market entry and exit is displayed in detail by Figure 4-1. Although the probability of market entry is positively correlated with firm age, reflecting an expansion of international business activities as the firms grow older, the prediction of market entry in the first years after firm foundation is associated with a high uncertainty. The predicted probability of remaining an exporter has a negative slope. This is, however, a result of the composition of our sample. Nearly all exits from the foreign market occur between the 1997 and the 2003 surveys. In 2003, the firms were at least 7 years old. Only one firm left the foreign market between start-up and 1997. Thus, for young firms, we only observe transitions from the status of exporter to the status of exporter, resulting in a negative but insignificant coefficient.

The share of R&D expenditures to total sales is positively significant in both columns in Table 4-4, indicating a higher chance of firms that invest intensively in R&D reaching the status "exporter".

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[62] Setting all independent variables, including number of employees, to their mean, the predicted probability of remaining an exporter in the rare event logit model is 93.61 %. In comparison, applying the conventional logit model, i.e., without the correction described in section 4.2.3, results in a predicted probability of 98.70 %. Thus, in contrast to the unbiased estimator (i.e., the rare event logit model), the conventional logit model overestimates the probability of the more frequent event, that is, the probability of staying in the foreign market.

R&D activities can be expected to create assets within a firm that are difficult for the firm's rivals to imitate. This facilitates the firm's internationalisation process as predicted by the resource-based view of the firm and Dunning's OLI framework. The positive relationship between R&D intensity and the predicted probabilities of transition can also be seen in the lower graphs of Figure 4-1. The coefficients of the other two variables, included in the estimation equations to approximate the innovativeness of the firms' products (dummies for novel technology that was either developed in-house or elsewhere by another company), are not significant at any conventional level. Since all three variables are intended to approximate the firms' innovative products, the effect of applying a novel technology might already be covered by the R&D intensity. Moreover, it can be argued that dummy variables indicating those firms that produce with novel technology are no longer suitable to discriminate between firms as was the case for the cross section of the first survey. In 2003, the share of firms that produced using a novel and self-developed technology was significantly higher than it was in the cross section of the first survey. Conversely, the percentage of firms of which the best-selling product merely incorporates "tried and tested" combinations of existing technology (i.e., the lowest degree of innovativeness among the list presented to the interviewees) was considerably smaller in 2003 than at time of the first survey. Furthermore, firms that participated in both surveys often changed their production technology from a tried and tested technology to a novel technology between 1997 and 2003.[63] Hence, a dummy variable indicating a novel (and self-developed) technology no longer has discriminatory power.

All cited theories from the field of international management emphasise the role of experienced managers in the internationalisation process. The results show that managers who acquired international experience before entering the firm facilitate the firm's international business activities: If one member of the management team has work experience abroad, the firm is more likely to enter the foreign market. Similarly, if at least one manager was educated abroad, his firm is less likely to exit the foreign market. Entering a foreign market obviously requires the firm's manager to be familiar with foreign business practices and market conditions. Such familiarity can be best acquired by working abroad. A permanent international engagement, however, can be better assured by managers that have experience of living abroad, gained while studying in a foreign country. Managers with experience of living abroad are able to assess the preferences and needs of foreign customers, allowing them to develop long-term business relations. These results support both the internationalisation process model, which states that an internationally experienced management

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[63] Although this is beyond the capacity of our data to prove, it is consistent with our results that using a novel technology was a prerequisite for survival until 2003.

team can overcome the uncertainty present in foreign markets, and the resource-based view of the firm that regards international experience as an intangible asset that differentiates firms from their competitors. On the other hand, there is no evidence for the entrepreneurial perspective of the firm's internationalisation process. Shortages of skills in sales/distribution are not significant in either of the two coefficient vectors. Shortages of skills in production/R&D do not affect the probability of remaining an exporter, but reduce the probability of entering the foreign market – although the respective dummy variable is only significant at the 10 % level. If a firm is managed by a technical entrepreneur (i.e., someone without shortages) who is mainly interested in technology, the firm is more likely to become an exporter. This result even contradicts the entrepreneurial perspective and the hypotheses derived by Andersson (2000). However, a technical entrepreneur has the ability to create intangible assets which facilitate a firm's international engagement. Nevertheless, performing a Wald test does not reveal any joint significant effect of the two dummy variables indicating shortages of competencies (transition from non-exporter to exporter: $\chi^2(2) = 3.71$, [Prob $> \chi^2$] = 0.157; transition from exporter to exporter: $\chi^2(2) = 0.07$, [Prob $> \chi^2$] = 0.967).

As expected, intense customisation is a barrier for international business activities. Even firms that have exports tend to exit the foreign market, probably because they have underestimated the costs that arise from their products' high customisation requirements. The necessity of regular maintenance and upgrades, on the other hand, does not show any effect on firms' exporting activities. Furthermore, to whom the product is sold is not important. The dummy variable identifying the product as a consumer good or service is also not significant. Hence, assessing the chances and risks of exporting should not be done by identifying a typical customer of a firm's product, but by evaluating the product's transaction costs, especially the need for individual client customisation.

The empirical model fits well with the data. In the logit model explaining the determinants of a transition from the status "non-exporter" to the status "exporter", McFadden's R² reaches a value of 0.317. This value is quite high, indicating that a large part of firm-specific heterogeneity is in fact observed and able to discriminate between exporters and non-exporters. For the rare events logit model that determines the probability of staying an exporter, however, McFadden's R² is not of much use, because the rare event logit is an unbiased estimator that does not maximise a likelihood function. In fact, the rare event logit estimator fits the data less well than the ordinary logit model, but the former has a smaller mean square error. In the transition equation explaining foreign market entry, a Wald test of joint significance of the entire vector of exogenous variables clearly rejects the null hypothesis that all coefficients (except of the integer) are equal to zero. In the rare event logit model, however, the same null hypothesis cannot be rejected. This is probably

a result of the large number of (individually insignificant) variables that are included in the model. Estimating a reduced rare event logit model that merely comprises those five variables that are significant in rare event logit estimation presented in Table 4-4 reveals that these five variables are jointly significant and can explain a firm's exit from the international market ($\chi^2(5) = 19.44$, [Prob > χ^2] = 0.002).

4.2.5 Conclusion

This section focuses on the long-term export behaviour of our sample's firms. The first conclusion is that the shares of German and UK firms that sell their products and services abroad are comparably high in both 1997 and 2003. Moreover, in both countries we observe a relatively high persistence in the firms' foreign market participation. The econometric analysis reveals that firms located in Eastern Germany have a lower probability of entering the foreign market. The other country-specific dummy variables are not significant, indicating that further differences between German and UK firms with respect to foreign market entry and exit are covered by our model. However, as already discussed in chapter 3, it is impossible to determine econometrically whether these differences are a result of a varying endowment with firm-specific resources or whether the influence on the exogenous factors differs between German and UK-based firms.

The second result of this section already becomes apparent from the descriptive analysis. Although there is a high persistence in the firms' international business activities, we observe entry into and exit from the foreign market. Only 15 % of the firms in our sample have never had international sales. The phenomenon of non-persistent export participation trajectories has already been highlighted by Roberts and Tybout (1997) and confirmed, among others, by Bernard and Jensen (2004). Analysing long-term international business activities, therefore, requires examining both entry and exit. However, the theories from the field of international management that were described in section 4.1 and that were used to identify firm-specific variables that may influence firms' internationalisation behaviour (stage models of internationalisation, the entrepreneurial perspective of internationalisation) are limited to foreign market entry. This study goes beyond this restricted view by examining empirically firm-specific characteristics that are able to discriminate between firms that enter the foreign market and firms that eschew it, and, additionally, to discriminate between firms that exit from the foreign market and those that remain internationally active.

Previous empirical studies of firms' export activities have focused on sunk costs as the main reason for the observed persistence in export behaviour. Although our data set is not suitable for providing empirical proof of the existence of sunk costs, our results are consistent with the sunk

costs hypothesis. Not only do we observe a high persistence in the internationalisation status which can be expected if sunk costs are relevant, but some results of the logit regressions can also best be interpreted by assuming the existence of sunk costs, for instance, the lower probability of engineering firms exiting the foreign market.

Sunk costs present a barrier to entering the international market. The ability of a firm to overcome this barrier is influenced by the firm's idiosyncratic bundle of assets as predicted by the resource-based view of the firm as well as Dunning's eclectic framework and supported by the data. In particular, the results highlight the strategic role of investment in R&D. R&D activities generate assets by which a firm distinguishes itself from its rivals. These assets not only facilitate foreign market entry, but also support a long-term engagement in the international market. Firms that had never had international sales before 2003 and firms that had exited the foreign market spent a significantly smaller share of total sales on R&D in 2003, as shown by the descriptive analysis. Since all of the firms in our sample operate in high-tech sectors, the firms' R&D activities constitute an essential asset that differentiates between firms and correlates with their international business activities. In addition to R&D intensity, the international experience of firms' managers is an important asset that helps firms internationalise. Interestingly, foreign market entry and exit depend on different knowledge. Whereas market entry requires managers' familiarity with foreign business practices, staying in the foreign market is supported by managers who are able to assess preferences and needs of foreign customers.

Finally, the success of a firm's international engagement depends on the characteristics of its product. High client-specific product customisation is a barrier to entry into the foreign market. If a firm has to consider the special needs of each customer, it will be difficult to realise economies of scale and fully profit from the foreign market's sales potential. Firms that had entered the foreign market with a product requiring intensive product customisation often stopped exporting, likely because they recognised that exporting was not profitable for them. Exporting a customised product may only be profitable if a firm can sell its product to a limited number of key foreign customers that represent sufficient sales potential for the supplying firm.

4.3   The Degree of Internationalisation

The second dimension of a firm's international engagement that is examined in this chapter is the degree of internationalisation. In the related literature, the share of non-domestic revenues is the most widely adopted measure of the degree of internationalisation (see Sullivan 1994b for an extensive review) and is therefore also used in this section.[64] Of course, a firm's international business activities can have multiple dimensions. It has already been mentioned that in this study only internationalisation on the sales market is considered, neglecting the import of investment goods or components, i.e., internationalisation on the procurement market. Sullivan (1994b) discussed other dimensions of a firm's involvement in foreign markets and proposed an alternative measurement he called the "degree of internationalisation scale", which is a linear combination of five ratio variables: foreign sales as a percentage of total sales, foreign assets as a percentage of total assets, foreign subsidiaries as a percentage of total subsidiaries, the number of years of work experience abroad of the top management team as a percentage of their total number of years of work experience, and the psychic dispersion of international operations.[65] Sullivan argued that this multidimensional measure is superior to a single item criterion like the share of total sales generated abroad, in particular because the latter is vulnerable to random and systematic measurement errors. In fact, the export-sales ratio is not only influenced by a firm's decision to expand or reduce its export activities: A random shock in the (real) exchange rate can inflate or deflate a firm's foreign sales, leading to a substantial change in the export-sales ratio. Similarly, increasing sales on the domestic or foreign market due to a demand shock in the respective market may alter a firm's export intensity, even if firm managers did not pursue any plan to adjust their degree of internationalisation. An observed change in a firm's export intensity may even be misleading. The firm may have been successful in increasing its volume of exports, indicating an expansion of its international business activities. However, if the firm's domestic sales have grown faster than its exports the export-sales ratio decreases, reflecting a reduced engagement abroad. A multidimensional criterion can lower the risk of a misleading interpretation since it is less sensitive to random shocks that influence one single item but have no effect on the other items of the criterion.

Sullivan's measurement of a firm's degree of internationalisation seems, nevertheless, to be inappropriate for our purpose. Some ratios that were included in Sullivan's multidimensional criterion are not observed in our data set. In particular, we do not have any information about the volume of

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[64]   In some studies, the degree of internationalisation is denoted as the export-sales ratio or as a firm's export intensity. In the following, these three expressions will be used interchangeably.

[65]   This ratio is an estimate of the psychic dispersion of the firms' subsidiaries among the ten "psychic zones" of the world (see Sullivan [1994b] and Ronen and Shenkar [1985] for more details).

foreign assets a firm holds, nor about the number of its subsidiaries that are located abroad. However, considering that our sample consists of young and small firms, most of them are not expected to have more than one (domestic) subsidiary. In fact, in 2003 only 11 % of our sample's firms (i.e., 18 companies) indicated having production facilities in at least one foreign country. Moreover, the most frequently used sales modes in the firms' foreign markets were direct exports and exporting via foreign intermediaries (see section 4.4). This means that most firms do not even possess a foreign sales subsidiary, i.e., they are likely to own only a small amount of international assets. Therefore, these two items Sullivan proved to be relevant for his sample of large US-based manufacturing firms are probably not suitable for describing the extent of our sampled firms' international business activities.

Similarly, it is questionable whether the psychic dispersion of international operations is able to discriminate between firms in our sample of small technology-oriented companies. As will be shown in section 4.4.2, more than 70 % of the firms' three most important target countries either belong to the European or the North American market. Thus, the psychic distance between the domestic country (Germany or the UK) and most of the chosen destination countries is unlikely to be very large. Finally, in this study the last item Sullivan included in his multidimensional criterion, i.e., the firm managers' work experience abroad, is regarded as an independent variable that is supposed to explain the firms' internationalisation behaviour. Since firm managers were asked to indicate whether they had work experience in a foreign country *before* joining the company, this variable is clearly exogenous and not a result of the firms' decisions.

Thus, although a multidimensional criterion has some advantages, I follow most other studies and measure a firm's degree of internationalisation by its share of total sales generated abroad.[66] Some studies, e.g., Calof (1993) and Wolff and Pett (2000), use the degree of internationalisation as an indicator of a firm's performance on the foreign market. This interpretation of export intensity is problematic. Firstly, export performance should be related to each single target market rather than to the worldwide volume of exports. Secondly, as argued above, even in the case of a decreasing export intensity, a firm might have been successful in the foreign market if domestic sales grew faster than foreign sales. Nevertheless, as the descriptive analysis will show, the firms in our sample were on average able to raise their export-sales ratio from 1997 to 2003. Considering that

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[66]   Moreover, Ramaswamy et al. (1996) argued that although an aggregate measure that captures the different aspects of internationalisation is desirable, a simple linear index like that of Sullivan (1994b) is not suitable for reflecting the complexity of a firm's internationalisation behaviour. Since our current knowledge about internationalisation is still limited and we do not yet understand how the varying components are related to one another, the use of a simple index in an econometric analysis may prevent us from gaining further insights into the relationships between the different dimensions of internationalisation.

during the same period total (discounted) sales of most of our sample's firms grew significantly, it becomes evident that young high-tech firms in Germany and the UK increased their volume of exports as well as their export-sales ratio. In this sense, the firms in our sample can be regarded as successful exporters. Before presenting descriptive statistics of our firms' export intensities, this section starts with a short discussion of the theoretical and empirical literature on how to appropriately model the degree of internationalisation.

4.3.1 Literature Review

According to Roberts and Tybout's (1997) dynamic model explained in detail in section 4.1, a rational firm i maximises its profits π_{it} by selling the profit-maximising level of exports q_{it}^* abroad. It is further assumed that the firm is always able to produce the profit-maximising level of exports q_{it}^*. The firm will export q_{it}^* in period t if the period's profit is non-negative. Otherwise, the firm will not have any international sales and will confine itself to the domestic market. As already discussed, this rule is moderated if sunk costs of foreign market entry, for instance, the costs of a marketing campaign or of setting up foreign sales channels, are prevalent. In this case, firms may continue to export even if foreign sales are no longer profitable in the current period in order to avoid re-entry costs. Regardless of the existence of sunk costs[67], it is important to note that the decision to internationalise and the choice of the profit-maximising level of exports are made simultaneously. Consequently, both decisions are determined by the same independent variables, i.e., in the case of Roberts and Tybout's model, a set of variables exogenous to the firm, X_{it}, and firm-specific variables Z_{it} such as firm size or product characteristics.

Wagner (2001) outlined this relationship when discussing how to model the export-sales ratio appropriately. Since foreign market entry and the profit-maximising volume of exports are chosen simultaneously, the firm's decision-making process has to be modelled as a one-step approach. In the related literature, however, the degree of internationalisation is often examined econometrically using two-step approaches (see, among others, Wakelin 1997). In the first step, the firm decides whether to internationalise or not and in the second step the optimal volume of exports is selected. The second equation is, of course, only defined for the subsample of firms with international sales. Estimating the second step econometrically therefore demands consideration of the probability of being an exporter, which is determined by the first equation (i.e., a possible sample

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[67]   Even if some costs can be regarded as sunk costs after entering the foreign market (i.e., ex post), there are no sunk costs ex ante. Firms have to consider these costs when deciding whether to export or not.

selection bias has to be taken into account; see, e.g., Greene 2000). In order to identify the first equation, two-step approaches require independent variables that can explain the decision of foreign market entry but do not affect the degree of internationalisation, that is, the dependent variable of the second equation. However, as has been argued from a theoretical point of view, a one-step approach is best to explain the degree of internationalisation, and all variables relevant to the market entry decision are also expected to influence the volume decision. Thus, it is not a surprise that Heckman's selection approach estimated by Bürgel et al. (2004) when examining the export intensity of the firms participating in the first survey did not perform very well. It was not possible to identify the first step of the econometric model.

Since the export-sales ratio is determined by the same independent variables as the probability of export market participation, the theories from the field of international management that were presented in section 4.1 are also suitable to explain varying degrees of internationalisation. For example, process models and stage theories (e.g., Johanson and Vahlne 1977, 1990) suggest that firm size and export intensity are positively correlated. Similarly, firms carrying out R&D activities more intensively, thereby creating firm-specific intangible assets, are expected to have a higher degree of internationalisation according to the resource-based view of the firm (e.g., Penrose 1959, Wernerfelt 1984) and Dunning's eclectic framework (Dunning 1993).

The positive relationship between a firm's R&D activities and its export intensity is confirmed in the related econometric literature. Estimating a Tobit model[68], Bürgel et al. (2004) proved that R&D intensity positively affects the degree of internationalisation of those German and UK-based high-tech firms that participated in the 1997 survey. Further, the regression results showed that a higher degree of innovativeness incorporated into the firm's best-selling product increases the observed export intensity. Wakelin (1997), estimating a truncated regression model using a data set of exporting UK manufacturing firms, found that firm-specific R&D intensity boosts a firm's export-sales ratio. A positive correlation between a firm's R&D intensity and its degree of internationalisation could also be confirmed by Dhanaraj and Beamish (2003) for a sample of US-based and Canadian exporters and by Barrios et al. (2003) for a sample of Spanish firms.[69] Similarly, examining a sample of German manufacturing firms from Lower Saxony, Wagner (2001) obtained positively significant coefficients for three dummy variables indicating different levels of R&D

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[68]   The Tobit model is a special case of Heckman's sample selection model. In this case, the selection equation is the same as the level equation being estimated (see, e.g., Greene 2000). The application of the Tobit model for estimating the degree of internationalisation can be criticised from an econometric point of view. For a detailed discussion, see Wagner (2001) and section 4.3.3.

[69]   Barrios et al. (2003) found further evidence of positive effects of R&D spillovers on firms' export ratios.

intensity (compared with firms without any R&D activities). Further, the firms in Wagner's sample exhibited a higher export intensity if they had registered at least one patent or if they had introduced at least one new product. These relationships are independent of the econometric method applied (OLS, Tobit, Beta regression, GLM regression [cf. Wagner 2001]). Thus, it could be regarded as an econometrically proven fact that firms that possess intangible assets, which are primarily created by intense R&D activities, can realise higher export-sales ratios.

It is also a well-known stylised fact that the degree of internationalisation increases with firm size. Wagner (1995, 2001) summarised theoretical arguments as to why firm size may be important for a firm's international business activities: Larger firms can fully exploit the potential of the foreign market by realising economies of scale in production. They can profit from bulk purchasing if they are able to exploit the additional potential of the foreign market. Large firms can raise financial resources at a lower cost than small firms and are able to bear higher risks when entering the foreign market (e.g., due to internal diversification). The latter argument corresponds to Johanson and Vahlne (1990), who expect large firms to have enough (financial) resources to take larger steps in their internationalisation process. Finally, some costs related to a firm's international business activities are fixed costs, for example, carrying out market studies or finding a foreign distributor or agent. The larger the firm, the smaller the unit costs of these activities. On the other hand, if a firm increases its international engagement the costs of coordination will also rise and sometimes begin to escalate when some critical threshold of internationalisation is exceeded. Managers interviewed by Geringer et al. (1989) reported having to institute new organisational structures and mechanisms of control when expanding their international business activities in order to avoid a decrease in their firms' profits.[70]

Thus, the relationship between export intensity and firm size is expected to be positive but non-linear and to decrease with size. Econometric studies estimating the impact of firm size on the firm's degree of internationalisation therefore contain not only a measure of firm size (e.g., the number of employees) but also its squared value in the regression equation. Consistent with the theoretical considerations, most studies, including Wagner (1995, 2001), Wakelin (1997), and Barrios et al. (2003), found a positively significant coefficient of firm size and a negatively significant one for its squared value. However, Wagner (2001) showed that this inversely U-shaped relationship is confirmed for some but not for all manufacturing industries in Germany. Moreover,

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[70]   The main focus of the analysis by Geringer et al. (1989) is the relationship between firm performance and the firms' degree of internationalisation, which is beyond the scope of this study. Geringer et al. found an "internationalisation threshold" beyond which firms' profit margins erode. See also Sullivan (1994a) for a thorough discussion of the work of Geringer et al.

Wagner (2003) extended his own analysis by controlling for unobserved firm heterogeneity in his data set. More precisely, he applied a fixed-effects version of the fractional logit regression developed by Papke and Wooldridge (1996) (see section 4.3.3). If, however, unobserved heterogeneity was considered when estimating the model, firm size (and its squared value) became insignificant. Both the results of Wagner (2001) and of the same author's 2003 study suggest that it is not size *per se* that allows a firm to increase its degree of internationalisation. At least in some industries, smallness need not be a barrier to becoming a successful exporter. These insights are of interest in particular for the small technology-oriented firms in our sample. In fact, Bürgel et al. (2004) did not find an effect of (start-up) size on the degree of internationalisation when estimating a Tobit model using data of those firms that participated in the first survey in 1997.[71] Although firm size turned out to be relevant for the decision to enter or exit the foreign market (see section 4.2), it did not discriminate between firms with varying shares of foreign revenues in 1997. This section will therefore investigate whether these results stay valid if, firstly, a more appropriate econometric method is used in order to estimate the firms' export intensity (i.e., a fractional logit model instead of a Tobit model) and, secondly, as the firms in our sample reach a "mature" stage of their life cycles while growing and, in most cases, expanding their international engagement.

4.3.2 Descriptive Analysis

The econometric analysis in the subsequent section will be based on data from the surveys conducted in 1997 and 2003. I will estimate a fractional logit model as developed by Papke and Wooldridge (1996) using the pooled sample (i.e., data from both surveys) and a separate sample for each of the two points in time observed in order to test whether there are differences in the determinants of the degree of internationalisation between 1997 and 2003. The following descriptive analysis therefore includes statistics for the pooled sample as well as for the respective sub-samples of 1997 and 2003.

In 1997 the firms in our sample generated an average of 23 % of total sales in the foreign market. In the period between the two surveys, the average export intensity rose by 8 percentage points to a value of 31 % in 2003. It is important to note that these average numbers include not only exporting firms but also companies without international sales. The latter group of firms decided that their optimal volume of exports was zero. Thus, the degree of internationalisation has many limit observations at the value zero (about a quarter of all observations).

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[71] The squared value of firm size, measured by (the logarithm of) the number of employees, was not included in their specification (see Bürgel et al. 2004).

As discussed in section 4.2.2, the percentage of internationally active firms in our sample increased only slightly from 1997 to 2003. Hence, the higher average export intensity is only to a small extent a result of additional firms entering the international market. The rise in the sample's export-sales ratio is mainly caused by the expanding international business activities of continuously exporting firms: The average share of total turnover the sample's *exporters* generated through foreign sales went up from 33 % in 1997 to 43 % in 2003. Similarly, the percentage of exporting firms in which non-domestic revenues exceeded 50 % of total revenues increased from 26 % in 1997 to 37 % at the time of the second survey. These numbers become even more impressive if we consider that (discounted) sales of firms that had exports in 2003 grew on average by 14.6 % per year from 1997 to 2002 (see section 4.1 for a detailed discussion of firm growth and its relationship to the firms' international business activities). Thus, the annualised growth rates of the firms' volume of exports had to be even higher so that the mean ratio of exports to total sales could increase.

Table 4-5:   Comparison of Mean Degree of Internationalisation

Exporters and non-exporters

	Germany	UK	t-test
Pooled sample	19.8	33.5	***
1997	16.5	28.9	***
2003	23.2	38.2	***
	West Germany	**East Germany**	
Pooled sample	23.5	12.8	***
1997	20.7	8.3	***
2003	26.5	17.2	*

Exporters only

	Germany	UK	t-test
Pooled sample	28.6	44.5	***
1997	24.2	38.8	***
2003	33.0	50.1	***
	West Germany	**East Germany**	
Pooled sample	31.2	22.1	**
1997	27.8	14.8	**
2003	34.8	28.9	

* 10 % level of significance; ** 5 % level of significance; *** 1 % level of significance.

Note: Only firms that participated in both surveys were considered.

Source: ZEW, University of Exeter, own calculations.

This development corresponds to the trend highlighted in Table 2-5. The share of German manufacturing plants' total sales generated in the foreign market increased from 1996 to 2003. Moreover, the growth rate of aggregated domestic sales was smaller than the respective rate German manufacturing plants realised on the foreign market. Hence, the rising degree of internationalisation observed for the firms in our sample is not an exception but the rule and mirrors the increasing globalisation of high-tech markets.

On average, the degree of internationalisation of UK-based firms exceeds that of German firms (see Table 4-5). The difference is significant according to a conventional t-test. This statement is valid for the pooled sample as well as for the two subsamples of 1997 and 2003. Restricting ourselves to the group of exporting firms, Table 4-5 shows that the average export intensity of UK-based (German) firms rose from 39 % (24 %) in 1997 to 50 % (33 %) in 2003. In 2003, 51 % of UK firms with international sales generated more than 50 % of their total revenues abroad. In Germany, for only 17 % was the foreign market, in terms of sales, more important than the home market. Obviously, the degree of internationalisation was higher for UK-based exporters than for their German counterparts. This was the case at the time of the first survey and remained valid, although both UK and German firms had, on average, intensified their international engagement. As Bürgel et al. (2004) argued, this might be the case because British exporters more pro-actively exploit the sales potential of foreign markets or because German firms are less dependent on the international market due to the larger size of their domestic market.

Firms located in Western Germany achieve a significantly higher share of their total turnover abroad than firms from the eastern part of Germany. Recall that Eastern German firms demonstrate a lower probability of entering the foreign market. Thus, the smaller degree of internationalisation of Eastern German firms in the combined sample of exporters and non-exporters results from the smaller percentage of internationally active Eastern German firms as well as from the lower export intensity of Eastern German exporters. The latter fact is shown in the lower part of Table 4-5, where the degree of internationalisation is calculated for our sample's exporters only. Interestingly, whereas the difference of the average degree of internationalisation between exporters from the two parts of Germany amounted to 13 percentage points in 1997, this difference dropped to only 6 percentage points in 2003 and was no longer significant at the time of the second survey. Obviously, Eastern German firms face an initial drawback that reduces their probability of exporting and their degree of internationalisation during early stages of their engagement in the foreign market, e.g., because the regional spillover effects Western German firms may profit from were absent in Eastern Germany in the first years after German reunification. However, Eastern German exporters were able to overcome this disadvantage in the period leading up to 2003 and reach an

export intensity comparable with that of Western German exporters. This finding is consistent with the estimation results in section 4.2.4, where we found that, once they have entered the foreign market, Eastern German firms do not have a significantly higher probability of market exit compared with Western German (and UK-based) firms.

Table 4-6 shows the degree of internationalisation separated into the five aggregated high-tech sectors, considering data of exporting and non-exporting firms. In each sector at the time of both surveys, UK firms generated a higher share of total sales in the foreign market than their German rivals. With the exception of the sector of other high-tech manufacturing firms in the UK, the average export-sales ratio increased in both countries and in all the sectors examined from 1997 to 2003.[72] In Germany, software and service firms evinced the lowest average degree of internationalisation. On the one hand, the share of internationally active firms in the German service sector was smaller than in any manufacturing sector. However, even if a German service firm decided to enter the foreign market, its export intensity would, on average, fall behind that of a German manufacturing firm with international sales. In the UK, the observed mean degree of internationalisation of service firms was also smaller than that of manufacturing firms. Only firms from the sector of other high-tech manufacturing had on average a lower degree of internationalisation than British service and software companies in 2003. Further, in the UK all firms in the sectors ICT-hardware and health/life sciences had international sales in 2003. The reported degree of internationalisation in the last column of Table 4-6 is therefore higher than in any other sector where information on exporters and non-exporters was used in order to calculate the export intensities.

Table 4-6:   Degree of Internationalisation, by High-Tech Sectors

	Germany		UK	
Sector	1997	2003	1997	2003
Software/services	9.6	12.9	20.6	32.2
ICT-hardware	20.2	34.0	36.0	55.4
Engineering	24.7	38.5	33.7	48.5
Health/life sciences	19.3	30.4	54.0	63.8
Other high-tech manuf.	17.6	19.5	25.0	24.9
Total	16.5	23.2	28.8	38.2

Note: Combined sample of exporters and non-exporters was used.

Only firms that participated in both surveys were considered.

Source: ZEW, University of Exeter, own calculations.

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[72]   Recall that the sector of other manufacturing firms in the UK was the only sector where the share of internationally active firms decreased from 1997 to 2003 (see Table 4-2).

Table 4-7:   Degree of Internationalisation, by Size Classes

Number of employees	Germany		UK	
	1997	2003	1997	2003
5 or less	9.1	13.8	22.1	24.4
6 – 10	14.6	11.9	22.9	27.6
11 – 20	17.4	30.1	33.3	42.6
21 – 50	16.3	25.6	36.3	49.4
more than 50	53.0	31.1	29.8	44.1
Total	16.5	23.2	28.8	38.2

Note: Combined sample of exporters and non-exporters was used.

Only firms that participated in both surveys were considered.

Source: ZEW, University of Exeter, own calculations.

The relationship between the degree of internationalisation and firm size is of particular interest in this section. Therefore, Table 4-7 contains the average export intensities of our sample's firms in different size classes, where size is measured by the number of employees. The export-sales ratios for the subsample of UK firms exhibit the theoretically expected relationship. That is, the degree of internationalisation increases with firm size, but firms in the largest class (more than 50 employees) generate a smaller share of their total revenues abroad than firms in the second-largest class (between 21 and 50 employees), probably due to rising costs of coordinating their international business activities. The subsample of German firms does not show such an even picture. Nevertheless, firms with up to five employees reach a relatively small degree of internationalisation compared with larger firms. The majority of the firms in this size class do not even have international sales. At the time of the first survey, German firms with more than 50 employees generated on average 53 % of their total revenues in the foreign market. However, this impressively high figure is based on only four observations, all of which had international sales. In 2003 there were eleven firms in the German subsample that had more than 50 employees. Some of the firms that grew in the period between the two surveys, exceeding the threshold value of 50 employees, did not export in 2003, making the average degree of internationalisation significantly smaller when compared with the respective value in 1997.

4.3.3   Econometric Implementation

Wagner (2001) argued that all methods used before in the related literature in order to estimate the degree of internationalisation are seriously flawed. We have already discussed (in section 4.3.1) why two-step approaches like Heckman's sample selection model are not appropriate for explaining firms' export intensities. Some studies, including Wagner (1995), Wakelin (1997), and Bürgel

et al. (2004), used a Tobit model for estimating the export-sales ratio. However, the Tobit model is a censored regression, which is appropriate if the endogenous variable is only observed if it exceeds a limit observation (zero in most cases). Nevertheless, the endogenous variable can be less than the limit observation, but these observations are unobservable. In contrast to this, the degree of internationalisation cannot be smaller than zero. The limit observations arise because individual firms choose zero as their optimal volume of exports. There are no negative degrees of internationalisation that we simply cannot observe because of censoring. Therefore, the Tobit model is not suitable for our purpose (cf. Wagner 2001, Maddala 1991).

Following Wagner (2001, 2003), I instead apply the fractional logit model developed by Papke and Wooldridge (1996) for estimating the export intensity of the firms in our sample. Let Y_i denote the export-sales ratio of firm i, where $0 \leq Y_i \leq 1$. Papke and Wooldridge assumed that, for all i, the expected value of Y_i conditional on a vector of explanatory variables X_i is given by

$$(4.17) \quad E\left(Y_i \mid X_i\right) = F\left(X_i \beta\right),$$

with $0 < F\left(X_i \beta\right) < 1$ for all $X_i \beta \in \mathbb{R}$, ensuring that the predicted values of Y_i lie in the interval $(0, 1)$. Nevertheless, equation (4.17) is defined even if Y_i takes the limit observations zero or one. The function $F(\cdot)$ is assumed to be the cumulative distribution function (cdf) of the logistic distribution:[73]

$$(4.18) \quad F\left(X_i \beta\right) \equiv \Lambda\left(X_i \beta\right) \equiv \frac{\exp\left(X_i \beta\right)}{1 + \exp\left(X_i \beta\right)}.$$

Papke and Wooldridge proposed a quasi-maximum likelihood estimator (QMLE) of β, following Gouriéroux et al. (1984) and McCullagh and Nelder (1989). The Bernoulli log-likelihood function that is maximised is given by

$$(4.19) \quad \ln L = \sum_i \left\{ Y_i \ln\left[\Lambda\left(X_i \beta\right)\right] + \left(1 - Y_i\right) \ln\left[1 - \Lambda\left(X_i \beta\right)\right] \right\}.$$

The QMLE of β is consistent and asymptotically normal – *regardless* of the distribution of Y_i, i.e., Y_i could be a discrete variable or, as in our case, a continuous variable bounded between zero and one (see Papke and Wooldridge 1996, p. 622). Equation (4.19) is maximised using the generalised linear models (GLM) framework developed by McCullagh and Nelder (1989). However, the GLM approach assumes that

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[73] However, Papke and Wooldridge (1996) emphasised that $F(\cdot)$ may not necessarily be a cdf.

$$(4.20) \quad Var\left(Y_i \middle| X_i\right) = \sigma^2 \Lambda\left(X_i\beta\right)\left[1 - \Lambda\left(X_i\beta\right)\right], \quad \text{with} \quad \sigma^2 > 0.$$

This assumption may not be satisfied, e.g., if there are unobserved group effects. Therefore, Papke and Wooldridge suggested applying a robust estimate of the asymptotic variance of $\hat{\beta}$.

As discussed in section 4.3.1, the decision whether to enter the foreign market and the choice of the optimal volume of exports are made simultaneously and are therefore determined by the same independent variables. Thus, the set of exogenous variables used for estimating the degree of internationalisation is broadly identical with that explaining foreign market entry and exit in section 4.2, i.e., it will contain the industry real exchange rate[74] as a variable exogenous to the firm as well as a set of firm-specific variables that were derived from the literature of international management. The latter will include the logarithm of firm size (measured by the number of employees), its squared value, and the logarithm of firm age (measured in years). A firm's human capital is approximated by the two dummy variables indicating whether the firm's managers had work experience abroad or were educated in a foreign country; the absence of key management capabilities is measured by two dummy variables taking the value 1 if a firm's managers experienced a serious shortage of skills in sales/distribution and production/R&D, respectively. Further dummy variables indicating the requirement of intense product customisation and regular maintenance, respectively, and whether a firm's product or service is directly sold to end-users cover product characteristics that may influence the degree of internationalisation. Moreover, the innovativeness of a firm's best-selling product is determined by two dummy variables revealing whether the product incorporates novel technology that had been developed in-house or whether it merely incorporates novel technology that had been developed elsewhere by other companies.

In contrast to the econometric model explaining foreign market entry and exit, I will not use the firms' R&D intensities in this section's specification. Instead, I will consider two dummy variables that indicate whether a firm carries out R&D on a permanent basis or occasionally. In addition to R&D intensity, these two variables were gathered by the two surveys. Firms without any R&D activities are used as the base category. I also estimated fractional logit models that contained R&D intensity as an independent variable, but surprisingly, R&D intensity was not significant in these specifications. I do not have a convincing explanation for the different effects of two variables that are both intended to measure a firm's R&D activities.

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[74]   To estimate a potential effect, the industry real exchange rate has to vary over time. Thus, the exchange rate is only included in the pooled regression.

To control for regional and sector-specific peculiarities, I will add two dummy variables for firms located in Western and Eastern Germany respectively, using UK firms as the base category, and two industry dummies for the engineering sector and other high-tech manufacturing industries (including the relatively small sectors of ICT-hardware and health/life sciences). Thus, software and service firms will be the base category. Finally, when estimating the pooled sample I will include a year dummy taking the value 1 if the observation falls in the second period, i.e., in 2003. Of course, there will be no year dummy if data from only one survey (i.e., 1997 or 2003) are used.

4.3.4 Empirical Results

The estimation results of the fractional logit models are presented in Tables 4-8 (pooled sample) and 4-9 (subsamples of 1997 and 2003).[75] It is immediately apparent that the results of the pooled regression are very similar to those of the two separated regressions. Thus, both in 1997 and 2003 the degree of internationalisation is determined by essentially the same independent variables. There are no variables that lose their influence in the period between the two surveys and no additional variables that affect the export intensity only during a later stage of the firms' international engagement – at least no variables that were observed. However, looking at the results of the pooled regression we find that the time dummy indicating all observations of the second survey is positively significant. Setting all other variables to their mean, a discrete change of this time dummy variable from 0 to 1 (i.e., a hypothetical switch from 1997 to 2003) increases the export-sales ratio by just under 13 percentage points.[76] Thus, there is a shift of the endogenous variable in the period between the two surveys that is not covered by the remaining set of exogenous variables. In other words, our model is able to explain varying export intensities at a given point in time reasonably well, but it is unsuitable for representing the expansion of the firms' international business activities over time. Observing the firms in our sample over a longer time period and thus building up a panel data set may be a way to discover determinants of our firms' international expansion. For example, according to theory, firms decide simultaneously on foreign market entry and their preferred volumes of exports. However, due to limited resources exporters are probably not able to realise their optimal volumes of exports immediately after foreign market entry. Thus, firms may start their international engagement with a suboptimal volume of exports, gradually increasing their exports until the optimum volume is reached. This argument corresponds to that

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[75]   The model was estimated using the `glm` command of the software package STATA, version 8.2 SE. For a detailed discussion of estimating generalised linear models with STATA see Hardin and Hilbe (2001).

[76]   Note that Table 4-8 shows the estimated coefficients and not marginal effects or discrete changes of the dummy variables included.

explaining growth processes of newly founded firms: Start-ups are founded with a sub-optimal size, approaching their minimum efficient scale (MES) in the early years after firm formation (cf. section 5.2 for a discussion of young firms' growth processes). However, whether the rising degree of internationalisation from 1997 (i.e., an early stage of the firms' export activities) to 2003 can be regarded as an approach to an optimal value is beyond the scope of the analysis in this section. Alternatively, the increasing export-sales ratio can be interpreted as mirroring the rising globalisation on high-tech markets that was shown in Table 2-5 – at least for German manufacturing plants. In this case, the firms in our sample simply followed a global trend that cannot be explained by the firm-specific variables in our data set.

Table 4-8: Fractional Logit Estimation Results: Pooled Sample

	Number of observations = 356		
	LL = -151.852		
	$\chi^2 (20) = 146.63$		
	Prob > $\chi^2 (20) = 0.000$		
	$R^2 = 0.279$		
	Coeff.	*Robust stand. error*	
Time dummy (2003=1)	0.674	0.272	**
Industry real exchange rate	0.005	0.030	
West Germany	-0.460	0.187	**
East Germany	-1.097	0.239	***
Engineering	0.903	0.229	***
Other manufacturing industries	0.551	0.199	***
Log (number of employees)	0.474	0.417	
Log (number of employees) ^{2}	-0.036	0.065	
Log (age)	-0.059	0.304	
Permanent R&D activities	0.936	0.308	***
Occasional R&D activities	0.685	0.330	**
Novel self-developed technology	-0.169	0.168	
Novel techn., developed elsewhere	0.426	0.213	**
Work experience abroad	0.573	0.168	***
Education abroad	0.371	0.202	*
Shortage of competencies			
Sales/distribution	-0.255	0.173	
Production/R&D	0.082	0.188	
Intense product customisation	-0.506	0.165	***
Regular maintenance and upgrades	-0.156	0.177	
Consumer good	0.062	0.175	
Constant	-3.625	3.124	

* 10 % level of significance; ** 5 % level of significance; *** 1 % level of significance.

Base category: UK-based software firm without R&D activities.

Source: own estimation.

In section 4.3.1 it was argued that the decision to internationalise and the choice of the optimal export intensity are made simultaneously and that both decisions are thus determined by the same set of independent variables. Comparing the results of the fractional logit model with that of the logit regression explaining a transition from the internationalisation status "non-exporter" to the status "exporter" (i.e., foreign market entry) in section 4.2.4 confirms this theoretical assumption. The regressions reveal largely the same variables that significantly affect the probability of foreign market entry and the conditional mean of the export-sales ratio, respectively. Moreover, in both models all of the significant variables have the same signs. In the following I will therefore concentrate on discussing commonalities and minor differences between the two models.

Table 4-9:   Fractional Logit Estimation Results: Subsamples 1997 and 2003

	1997			2003		
	Number of observations = 173 LL = -70.615 $\chi^2(18) = 66.01$ Prob $> \chi^2(18) = 0.000$ $R^2 = 0.224$			Number of observations = 183 LL = -80.071 $\chi^2(18) = 93.32$ Prob $> \chi^2(18) = 0.000$ $R^2 = 0.210$		
	Coeff.	*Robust stand. error*		*Coeff.*	*Robust stand. error*	
West Germany	-0.269	0.297		-0.690	0.287	**
East Germany	-1.269	0.402	***	-1.041	0.286	***
Engineering	0.861	0.357	**	0.879	0.314	***
Other manufacturing industries	0.671	0.313	**	0.350	0.271	
Log (number of employees)	0.582	0.667		0.499	0.542	
Log (number of employees) ^{2}	-0.056	0.111		-0.038	0.082	
Log (age)	-0.034	0.372		0.002	0.505	
Permanent R&D activities	0.896	0.471	*	1.053	0.386	***
Occasional R&D activities	0.892	0.489	*	0.387	0.446	
Novel self-developed technology	-0.098	0.262		-0.338	0.239	
Novel techn., developed elsewhere	0.444	0.284		0.369	0.347	
Working experience abroad	0.630	0.276	**	0.552	0.224	**
Education abroad	0.219	0.309		0.398	0.259	
Shortage of competencies						
Sales/distribution	-0.126	0.297		-0.335	0.228	
Production/R&D	0.049	0.301		0.052	0.265	
Intense product customisation	-0.470	0.239	**	-0.616	0.229	***
Regular maintenance and upgrades	-0.180	0.291		-0.148	0.225	
Consumer good	0.040	0.233		0.280	0.289	
Constant	-3.498	1.382	**	-2.413	1.595	

* 10 % level of significance; ** 5 % level of significance; *** 1 % level of significance.

Base category: UK-based software firm without R&D activities.

Source: own estimation.

The industry real exchange rate influences neither the probability of foreign market entry nor the degree of internationalisation. As argued above, this is probably due to the small variance of this variable. In accordance with the descriptive statistics, the export intensity of German firms is significantly smaller than that of UK-based firms. Whereas firms from Eastern Germany are less likely to enter the foreign market and show a significantly lower export-sales ratio than UK firms, the probability of internationalisation of Western German firms is comparable with that of UK-based firms. Nevertheless, the degree of internationalisation of West German firms is smaller than the respective value of their British counterparts. For 1997, this difference can be explained by the remaining vector of exogenous variables. Between 1997 and 2003, both West German and UK-based firms raised their export intensity, but the expansion in the subsample of UK firms was larger. This resulted in an increased difference in the export intensity that can no longer be traced back to either varying firm-specific characteristics of German and UK technology-oriented firms or a different, country-specific functional form of the regression equation.

The two dummy variables indicating the two aggregated manufacturing sectors are both positively significant. In contrast to the estimated probability of foreign market entry, there is no difference between engineering firms and the other manufacturing industries. Recall, however, that the share of engineering firms with international sales is *not* smaller than that of the other manufacturing sectors.[77] Accordingly, the degree of internationalisation of engineering firms is similar to other manufacturing companies and higher than the export intensity in the software and service sector. For 2003 the dummy variable for the sector of other manufacturing firms is not significant, implying that at the time of the second survey there is no difference between this sector and software and service firms. This corresponds to the findings of the descriptive analysis.

R&D activities through which firms generate intangible assets in order to distinguish themselves from their rivals positively affect the degree of internationalisation. Whether a firm carries out permanent or only occasional R&D activities is not decisive. It is sufficient when a firm conducts any R&D activities at all – at least in 1997. At the time of the second survey, the dummy variable indicating occasional R&D activities is no longer significant. This variable likely no longer has discriminatory power in 2003 because the share of firms in our sample with occasional R&D activities reduced significantly from 1997 to 2003. Firms tended to decide to carry out either permanent R&D activities or no R&D activities at all. Moreover, the share of total sales that firms with occasional R&D activities spent on R&D also decreased. Whereas in 1997 the mean R&D

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[77]   In section 4.2.4 it was argued that these seemingly contradictory results might be due to the existence of sector-specific entry costs. Engineering firms are probably better equipped with firm-specific resources, enabling them to overcome these additional costs of entering the foreign market.

intensity of these firms amounted to 10.3 %, this value fell to 5.8 % in 2003. As a result, there is no significant difference in terms of the degree of internationalisation between firms with occasional R&D activities and companies that refrain from researching. The importance of (permanent) R&D activities for the firms' export intensity is consistent with the significant effect R&D intensity has on the transition into the foreign market, although the probability of internationalisation is positively related to the extent of a firm's R&D activities and not only to the fact that it carries out any research at all (see Figure 4-1). The remaining two variables that are intended to reflect the innovativeness of a firm's product, i.e., the two dummy variables indicating the firms' adoption of novel technology, are both not significant in the fractional logit estimations based on the two subsamples of 1997 and 2003. However, in the pooled regression the dummy reflecting the use of novel technology that was developed by other companies is positively significant, whereas the dummy variable indicating the adoption of self-developed technology has no effect on the degree of internationalisation. The impact of the latter variable is probably already covered by the two dummy variables indicating the extent of a firm's R&D activities. However, a firm can also create intangible assets by buying novel technology from other companies and incorporating this technology into its production process, i.e., without conducting its own R&D activities. Thus, the effect of the dummy variable indicating the use of technology that was developed elsewhere is plausible, although it was not found in other regression models of this study.

A firm's engagement in the foreign market is facilitated by the international experience of the members of its management team. If at least one firm manager has work experience abroad, this increases the probability of foreign market entry as well as the degree of internationalisation. The results of the fractional logit models reveal that the respective dummy variable is positively significant using data from the pooled sample and the two subsamples from 1997 and 2003. If a firm manager is familiar with foreign business practices and market conditions due to experience acquired while working in a foreign country, the company is able to attain a higher export-sales ratio. The dummy variable indicating whether at least one manager was educated abroad before joining the company is only significant in the regression using pooled data and at the 10 % level. Estimating the two subsamples, this dummy remains insignificant at any conventional level. Arguing that the choice of the optimal volume of exports is determined by the same variables as foreign market entry, it is, at first glance, not surprising that firm managers' work experience abroad is more important than an education received in a foreign country. In fact, in section 4.2.4 we did not find any effect of foreign education on the probability of entering the international market. However, this variable significantly reduces the probability of exit from the foreign market. Those firms that refrain from exiting the international market generate a positive volume of exports. In this way, an

education received in a foreign country increases the degree of internationalisation, although the (marginal) effect is smaller than that of firm managers' work experience abroad.[78] [79] The other two dummy variables, reflecting firm managers' capabilities by indicating experienced shortages of skills in sales/distribution and production/R&D, are neither individually nor jointly significant.[80] This finding is in line with the results of the logit regressions estimating foreign market entry and exit, although the dummy variable reflecting a shortage of skills in production/R&D has a slight significant effect on the probability of becoming an exporter. Nevertheless, the two variables approximating firm managers' capabilities are jointly insignificant in the logit models explaining foreign market entry and exit.

The requirement for intense customisation is the only product-specific variable that affects the probability and the extent of our firms' international business activities. Neither the necessity of regular maintenance nor distinguishing to whom a firm's best-selling product is sold (directly to end-users or to other companies as an intermediate or investment good) enables us to discriminate between the firms in our sample. Product customisation is a barrier to entry into the foreign market. It impedes realising economies of scale and, as a consequence, restricts the volume of exports even if the firm has overcome barriers to entry. If a product requires client-specific customisation, the firm will often export its product to only a limited number of foreign customers, realising a degree of internationalisation that makes its international business activities profitable but that is smaller than the export intensity of other firms. The lower export intensity may nevertheless be optimal for the firm, given its additional (transaction) costs caused by the requirement for intense customisation.

Firm size and age are two core elements of the internationalisation process model developed by Johanson and Vahlne (1977, 1990). According to the model, a firm gradually increases its international business activities, resulting in a positive correlation between firm age and the degree of internationalisation. However, (the logarithm of) firm age reveals its insignificance in our econometric model. Again, this finding corresponds to the result obtained in section 4.2.4, where firm age was also not suitable for explaining foreign market entry and exit. Interestingly, the coefficient of firm age is not significant, even if the regression is based on the subsample of 1997. Some of

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[78]　Based on the pooled regression, the marginal effect of a firm manager's work experience abroad, i.e., the effect of a discrete change in the dummy variable from 0 to 1 on the degree of internationalisation (all other variables set to their mean) amounts to 11.0 percentage points; the respective value of the dummy indicating a foreign education is equal to 7.6 percentage points.

[79]　Following the aforementioned argumentation, the relatively small effect of foreign education may be a result of the relatively small number of foreign market exits we observed during the time period covered by our surveys.

[80]　Wald test of joint significance, based on the pooled regression: $\chi^2(2) = 2.30$, [Prob $> \chi^2$] = 0.317.

the firms in our sample (e.g., the group of "born globals") may pro-actively exploit opportunities on the foreign market, reaching their optimal export intensity at an early stage of their life cycle. These firms may overcome uncertainty present in the international market or other barriers to entry by, for example, employing internationally experienced managers. In fact, we found that this variable positively affects the degree of internationalisation. Thus, youth is not necessarily an obstacle to realising a high export intensity.

As discussed in section 4.3.1, the relationship between firm size and the degree of internationalisation is of major interest in the related literature. Most studies cited above found that firm size positively influences the export-sales ratio, but that this relationship is non-linear and decreases with size. The estimated coefficients of the fractional logit models do indeed show the expected signs, i.e., a positive sign for (the logarithm of) the number of employees and a negative one for its squared value. However, in contrast to other studies these effects are not significant. Figure 4-2 displays the predicted degree of internationalisation in dependence of the number of employees, with all other variables set to their mean. Each of the three graphs reveals the same picture: The predicted export intensity increases with firm size, but the marginal effect (i.e., the slope of the solid lines in Figure 4-2) declines as the number of employees rises. The confidence intervals point out that the uncertainty associated with predicting the export-sales ratio is larger for very small firms (read: less than 10 employees) than for medium-sized firms.[81] This means that in the group of very small firms, the share of firms without any international sales is comparably high. At the same time, there are some firms that generate the majority of their total sales in the foreign market, in spite of having less than 10 employees. Thus, the variance and the associated confidence intervals of the (predicted) degree of internationalisation are relatively large for the group of very small firms. Some small firms in our sample are able to overcome the barriers to entry into the foreign market since they possess intangible assets, e.g., generated by (permanent) R&D activities. We can conclude that firm size is not necessary to attain a high export-sales ratio. This finding supports the conclusion of Wagner (2003), who emphasised that it is not size *per se* that makes a successful exporter. However, Wagner (2003) had only little information on firm-specific variables that facilitate a firm's international business activities and enable the company to increase its export intensity. In Wagner's study, firm-specific differences were therefore considered by controlling for

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[81]   The confidence intervals of the predicted degree of internationalisation for firms with more than 50 employees are very large, in particular if data from the first survey only are used. In 1997 very few firms in our sample exceeded the threshold of 50 employees. For large firms, Figure 4-2 therefore constitutes an out-of-sample forecast. Whereas the probability of foreign market entry of large firms can be predicted with low uncertainty since most firms with more than 20 employees have foreign sales (see Figure 4-1), predicting large firms' export intensities is more difficult because the export-sales ratio varies considerably in our sample.

Figure 4-2: Predicted Degree of Internationalisation in Dependence of the Number of Employees

Pooled Sample
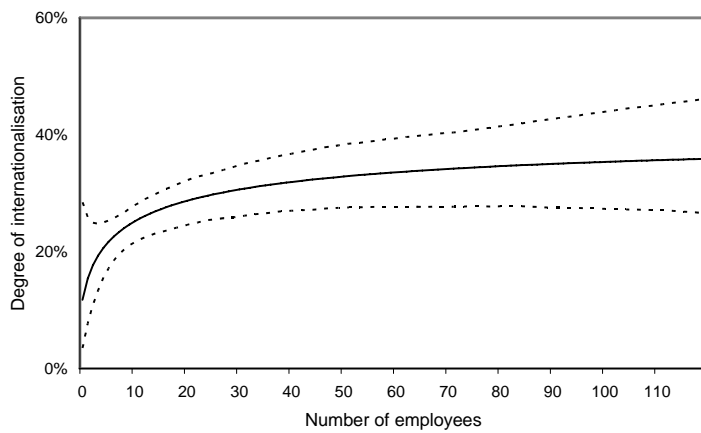
1997
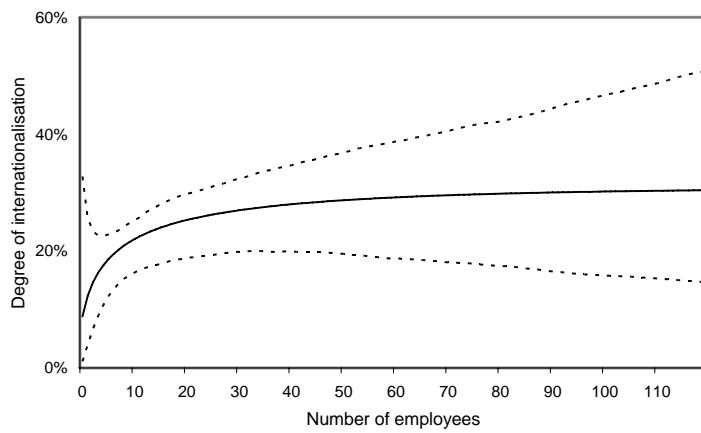
2003
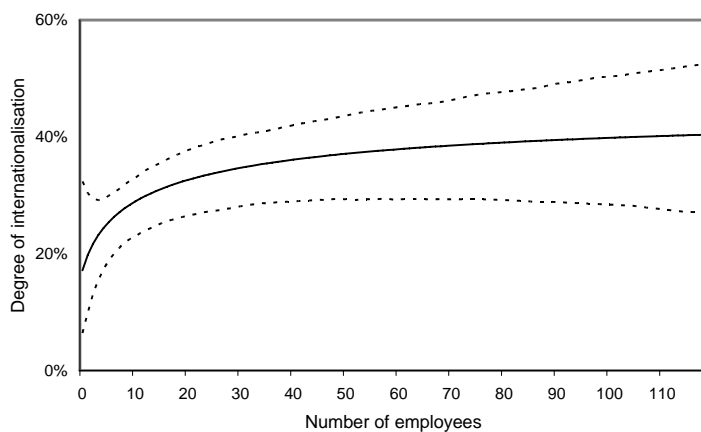
Solid line: predicted degree of internationalisation in dependence of the number of employees, all other variables set to their mean.
Dotted lines: simulated 90 % confidence interval, using the 5 % and 95 % percentiles of the bootstrap distribution (1,000 replications).
Source: own calculation.

unobserved firm heterogeneity. In this study, we can go one step further. Our data set enables us to identify firm-specific characteristics that determine the degree of internationalisation as discussed above, allowing firm-specific heterogeneity to be (at least partly) observed.

In order to test the validity of the model, I applied a specification test derived by Pregibon (1979). The concept behind the test is as follows: If the model is correctly specified, then in an auxiliary GLM regression of the degree of internationalisation on the prediction and the prediction squared, the prediction squared should not have any explanatory power. Thus, the alternative model is:

$$(4.21) \quad E\left(Y_i|X_i\right) = F\left(X_i\beta + \gamma\left(X_i\beta\right)^2\right),$$

where, again, $F(\cdot)$ is the logistic function $\Lambda(\cdot)$. Under the null hypothesis $H_0 : \gamma = 0$, the model is correctly specified, i.e., the test statistic is the conventional t-statistic of the quadratic term in the auxiliary GLM regression.[82] The specification test based on the pooled regression cannot reject the null hypothesis (t-statistic: -0.26). The quadratic term is likewise insignificant in the two auxiliary regressions that are related to the two subsamples (1997: t-statistic: 0.09; 2003: t-statistic: -0.53). Thus, Pregibon's specification test reveals no problems with the chosen specification.

The fractional logit model fits reasonably well with the data. As Papke and Wooldridge (1996) pointed out, the simple R^2, conventionally defined as $1 - SSR/SST$ (with SSR = sum of squared residuals and SST = total sum of squares), is the most appropriate goodness-of-fit measure, since only the conditional expectation of the degree of internationalisation is modelled, with other features of the conditional distribution left unspecified (see Papke and Wooldridge 1996, p. 629). The R^2 for the pooled regression is 0.279, which is satisfactory for a cross-sectional data set. The respective values for the regressions based on the two subsamples are only slightly smaller (1997: 0.224; 2003: 0.210).

4.3.5 Conclusion

After having examined the probability of foreign market entry and exit, this section analyses the share of total sales the firms in our sample generate abroad. While the participation rate in the international market increased only slightly from 1997 to 2003, the group of exporters in our sample expanded their international business activities significantly, raising the average degree of

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[82] Papke and Wooldridge (1996) used a similar specification test by extending Ramsey's (1969) Reset procedure. In addition to the quadratic term in equation (4.21), they further included the cubic term of the prediction in the alternative model. Under the null hypothesis, the regression coefficients of both the squared and the cubic term have to be jointly insignificant.

internationalisation from 33 % in 1997 to 43 % in 2003. At the time of the second survey, 37 % of the exporters even generated more than 50 % of their total revenues abroad. These are indeed impressive findings, indicating that the majority of newly founded technology-oriented firms in Germany and the UK were able to establish themselves in the international market. Unfortunately, the econometric model used in this section cannot explain the shift in export intensity in the period between the two surveys. Nevertheless, our model describes varying degrees of internationalisation at a given point in time reasonably well.

According to theory, a firm decides simultaneously on its participation in the foreign market and the optimal volume of exports. As a consequence, two-step econometric approaches are not appropriate for modelling the degree of internationalisation. Moreover, the Tobit model that is often used in the related literature is a censored regression and therefore also not suitable for estimating an endogenous variable that has many limit observations. These limit observations result from firms choosing zero as their optimal volume of exports. Thus, following Wagner (2001, 2003), I applied the fractional logit model developed by Papke and Wooldridge (1996) for estimating the degree of internationalisation.

The simultaneity of the two decisions implies that the probability of entry into the international market and (the conditional mean of) the degree of internationalisation are both to be determined by the same set of explanatory variables. In fact, comparing the regression results in section 4.2.4 with those presented above reveals that both decisions are affected by virtually the same variables. Essentially, firms that generate intangible assets through (permanent) R&D activities achieve a higher share of their total sales abroad. Similarly, if a firm employs internationally experienced managers it will be able to increase its export-sales ratio. These results confirm the resource-based view of the firm and emphasise the importance of ownership advantages according to Dunning's eclectic framework (cf. Dunning 1993). On the other hand, the optimal volume of exports is negatively influenced by the requirement of intense product customisation as predicted by the transaction costs analysis theory. The entrepreneurial perspective of the firm is, however, not supported: The (absence of) shortages of skills in sales/distribution and production/R&D are not significant.

The key result of this section is that neither youth nor smallness are necessarily an obstacle to realising a high export intensity. Firms that internationalise shortly after their inception ("born globals") pro-actively exploit the foreign market and reach a relatively high degree of internationalisation at an early stage of their international engagement. Similarly, even firms that have less than 10 employees are able to attain a high export-sales ratio. However, this requires that the firms possess firm-specific assets in order to overcome barriers to entry into the foreign market. As our

analysis shows, these firm-specific assets may be acquired via a firm conducting its own R&D activities, through buying novel technology from other companies, or by employing internationally experienced managers. It is important to note, however, that there is a considerable heterogeneity within the group of young and/or small firms. Figure 4-1 in the previous section reveals that a prediction of whether a firm belongs to the group of born globals, that is, whether it entered into the international market no later than one year after firm formation, is associated with high uncertainty (i.e., large confidence intervals). The same is true for a prediction of (the conditional mean of) the degree of internationalisation for very small firms (less than 10 employees). This implies that, apart from exporters like those in the group of born globals that pro-actively exploit the foreign market, there are firms that gradually increase their international engagement according to the internationalisation process model of Johanson and Vahlne (1977, 1990). In fact, the shift in the average export intensity that occurred in the period between the two surveys and could not be explained by our econometric model can be interpreted as a result of firms' step-by-step approaches to their optimal volumes of exports. Thus, for the latter group of firms the export-sales ratio may be causally linked with the firms' age and size. Nevertheless, for a large proportion of the firms in our sample, size and age are not prerequisites for realising a high degree of internationalisation. This leads to insignificant coefficients in the regression equations. If young and small technology-oriented firms in Germany and the UK acquire the necessary firm-specific resources, they will have the best qualifications for becoming successful exporters, or, as Wagner (2003) called them, "hidden export champions".

4.4   The Change of Sales Modes in International Markets

The choice of the appropriate sales mode belongs to the firm's most important strategic decisions after entering into a foreign market. Firstly, it determines the amount of resources a firm has to invest in establishing business relationships with its foreign partners and customers. Secondly, the way of organising the firm's distribution and logistics depends crucially on the chosen sales mode. For example, if a firm decides to export directly by using the Internet it will have to build up an electronic trade platform on its server and reorganise its logistics and workplaces in order to guarantee smooth handling of the orders it receives from abroad via the Internet. Alternatively, a firm that sells its product via a foreign distributor or agent needs to provide, for instance, technical training of the foreign intermediary's sales personnel and has to create incentives and monitoring mechanisms for controlling the foreign partner. Finally, the sales mode used determines the level of control the exporting firm possesses over its international transactions. If the exporter chooses a sales mode that is integrated in its hierarchical structure, like direct exporting or foreign direct

investment (FDI), this will ensure a high level of control. On the other hand, firms that export their products via an intermediary or that enter the foreign market via an acquisition or a joint venture with a strategic foreign partner have only a limited control over production and distribution of their products in the target country. Moreover, working together with a foreign partner also means that the domestic firm has to transfer its (technological) know-how to the foreign partner in order to enable it to produce or distribute the domestic firm's products. Thus, using a non-integrated sales mode implies a loss of control over the firm-specific know-how that often constitutes the firm's competitive advantage.[83]

Considering the far-reaching consequences of a sales mode choice, it is important that the foreign sales mode selected is best suited to a firm's available resources and capabilities. However, these resources and capabilities change over time. Firms grow and shrink, accumulate financial and physical capital, develop new products and introduce them into their domestic and foreign markets. Accordingly, it might be necessary for a firm to adjust its foreign sales mode to these changing firm-specific conditions. Otherwise, its selected sales mode might become inappropriate for selling the firms' products abroad. Unfortunately, the theoretical and empirical literature almost entirely neglects changes of sales modes. The internationalisation process model derived by Johanson and Vahlne (1977, 1990) describes a sequence of sales modes. However, this theoretical model is rather deterministic and its only, or at least its most important explanatory variable is the experiential knowledge a firm has acquired in a foreign target market. Thus, it is questionable whether this model is able to account for all the changing conditions a firm might be faced with. Probably due to data restrictions, most empirical studies that examine foreign sales modes concentrate on the firm's entry mode, i.e., the first sales mode a firm uses in a particular target market. Subsequent changes of sales modes are, or have to be, neglected.[84]

This section will address this gap. It analyses changes of sales modes of our sample of technology-based firms in Germany and the UK. Firms operating in high-tech sectors presumably experience profound changes during an early stage of their life cycles. Thus, provided that the firms have internationalised, it is of special interest to find out under which conditions the exporters in our sample change their foreign sales modes.

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[83]   The importance of choosing the appropriate sales mode also suggests that the firm's success in a particular target market will likely depend on the chosen sales mode. This question is, however, beyond the scope of this study. The relationship between foreign sales mode and firm performance is examined, e.g., by Beamish and Nitsch (1999), Zahra et al. (2000), and Lu and Beamish (2001).

[84]   Beamish and Nitsch (1999) provided a longitudinal analysis of sales modes. However, they did not focus on the firm-specific conditions for a sales mode change but attempted to explain why they did not find any performance differences between a joint venture and a greenfield investment when examining a longitudinal data set.

4.4.1 Theoretical Consideration and Literature Review

Several theories have been developed to explain firms' foreign market entry modes. The main strands of theory were summarised by Malhotra et al. (2003) who synthesised these different theories in order to derive a multitheoretical framework of internationalisation and entry mode choice. The theories reviewed by Malhotra et al. include: internationalisation process theory, the resource-based view of the firm in which theories of organisational capabilities are rooted, transaction cost analysis theory, and the eclectic paradigm.[85] All these theories have already been discussed in section 4.1. Most of them do not explicitly deal with sales mode changes but are restricted to the choice of the optimal sales mode when the firm is entering into the foreign market for the first time. Thus, at the end of this subsection the extent to which the reviewed theories are relevant for explaining changes in foreign sales modes will briefly be discussed.

Two notes have to be made first. Most theories investigating foreign market entry consider large companies that have to choose, for example, between exporting and foreign direct investment (FDI). Even in the case of internationalisation process theory where a small firm starts its international business activities with no regular exports and a low resource commitment, the final stage is FDI and foreign production – assuming continuous firm growth during the internationalisation process. However, the majority of firms stay small, never growing into a multinational firm with foreign subsidiaries. Nevertheless, the arguments derived in the existing theories remain appropriate, although, when examining young and small firms, we distinguish only between two alternative ways of exporting (direct exporting to end-users versus exporting via an intermediary; see section 4.4.2). The degree of resource commitment and the level of control of transactions are both relevant to discriminating between different modes of exporting, even if, for instance, the resources actually committed to the foreign market are markedly smaller than in the case of FDI. Further, it should be noted that in the following, the decision whether to export or not is taken as given, i.e., only the group of exporters will be considered. However, the theories discussed in section 4.1 proved to be appropriate for deriving firm-specific variables that influence the firms' export deci-

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[85] Additional to these theories, the review of Malhotra et al. (2003) includes, among others, international product life cycle theory, originally developed by Vernon (1966). This theory describes a four-stage sequence (domestic production and exports, foreign production, competition of foreign firms in the foreign market, foreign firm production and importing to the domestic market) contingent on the stage of the product's life cycle. However, since the firms in our sample all belong to a high-tech sector, presumably producing a product at an early stage of its life cycle, this theory is not suitable for discriminating between the varying foreign market entry modes of our sampled firms. Another theoretical approach neglected is network theory (e.g., Coviello and McAuley 1999, Coviello and Martin 1999, Bell 1995). Of course, networks are extremely important for young and small high-tech firms like those in our sample. However, the two surveys this study's analyses are based on do not include any information on networks used by the firms in the context of their internationalisation process. Thus, we are unable to examine any hypothesis that could be derived from network theory.

sion. Thus, the decision on the optimal entry mode might not be independent of the decision to sell abroad. This possible correlation will nevertheless be neglected.

The theoretical models reviewed in section 4.1 are complementary rather than substitutable. They contain some of the same explanatory variables, although the argumentation as to how these variables affect the firms' entry mode choice differs. It is thus not surprising that all the theories reviewed found empirical support. The validity of a theory for explaining the choice of the appropriate foreign entry mode depends, among other things, on the sector and size of the firms that have been examined. The key results of several empirical studies are summarised in Table 4-10.

Most theoretical and empirical research on entry mode choice is concentrated in manufacturing firms. Services, however, differ from manufactured goods. They tend to be personnel-intensive, inseparable (production and consumption are geographically and temporally linked), and perishable (services cannot be stored). Of course, many internationally marketed services are, in fact, separable. They are produced in the domestic country and transferred as a document, a disk, or via the Internet. This is especially true for computer and software services. Nevertheless, theories that were developed to explain the entry mode choice of manufacturing firms are not necessarily also applicable to service firms. Due to its general applicability, the eclectic paradigm is valid for manufacturing as well as for service firms. Brouthers et al. (1996) analysed theoretically and empirically whether Dunning's eclectic paradigm (Dunning 1993) could explain the entry mode selection of small software firms in the United States. They confirmed two hypotheses: (i) Software firms with greater ownership advantages are more likely to choose an integrated entry mode; (ii) Firms with greater locational advantages prefer an integrated entry mode.[86] The authors stressed that software firms in their sample behave like larger manufacturing firms. However, it is questionable whether these findings are transferable to other service sectors.

Similarly to the eclectic paradigm, the transaction cost analysis (TCA) theory is also applicable to both manufacturing and service firms. In order to consider the characteristics peculiar to services, Erramilli and Rao (1993) modified the TCA approach. They hypothesised that, e.g., inseparability causes additional costs and risks that have to be borne either by the firms themselves (an integrated entry mode) or by the chosen foreign partner (a non-integrated mode). According to Erramilli and Rao, a firm chooses a higher degree of integration the higher the transaction costs specificity of the firm's service is (e.g., a technically sophisticated service). Brouthers and Brouthers (2003) pointed out, however, that in the case of (external and internal) uncertainty, internal organisational costs

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[86]   In their empirical analysis Brouthers et al. (1996) neglected internalisation advantages.

Table 4-10: Empirical Studies on the Decision on Foreign Market Entry Modes

Internationalisation Process Model	Resource-Based View / Organisational Capabilities (OC)	Transaction Cost Analysis (TCA)	Dunning's Eclectic Paradigm
Barkema et al. (1996) 225 FDIs of 13 large Dutch firms; firms learn from their previous experience when gradually expanding their international business activities. Learning effects are only relevant in the case of low-control FDIs (acquisitions or joint ventures).	*Madhok (1998)* US and European multinational manufacturing firms; the OC perspective is most efficient in explaining firms' entry mode decision. Firms may often need to trade off transaction cost-related concerns against capability-related ones.	*Hennart (1991)* Japanese manufacturing firms investing in the US; high transaction costs on the US market increase the degree of ownership taken by Japanese firms in their US subsidiaries.	*Tse et al. (1997)* Multinational firms investing in China; locational advantages affect the probability of choosing an equity-based entry mode and whether a firm will enter with a partner or not.
Delios and Henisz (2003) FDIs of Japanese manufacturing firms; firms with a high level of experiential knowledge are less sensitive to the effects of uncertain policy environments on investments.	*Ekeledo / Sivakumar (2004)* US manufacturing and non-separable service firms; the resource-based theory has good explanatory abilities for entry mode strategies of both manufacturing and non-separable service firms. However, the impact of firm-specific resources on entry mode choice differs sometimes between the two groups of firms.	*Brouthers / Brouthers (2003)* Manufacturing and service firms from Western Europe entering Central and Eastern European Markets; due to the investment-intensive nature of manufacturing, environmental uncertainties influence manufactures' mode choice; due to the personnel-intensive nature of services, behavioural uncertainties influence service providers' entry mode choice.	*Brouthers et al. (1999)* German and Dutch firms entering into Central and Eastern Europe; firms that possess high OLI advantages tend to prefer more integrated entry modes.
Sharma / Johanson (1987) Swedish technical consultancy firms; resource commitment is of minor significance for the internationalisation process.			*Nakos / Brouthers (2002)* Small and medium sized Greek firms entering into Central and Eastern Europe; OLI advantages explain 85 % of mode choices.
O'Farrell et al. (1995) Small and medium sized UK-based business service firms; the process model was rejected, the most common entry mechanism was responding to a particular ad hoc order.	*Bürgel and Murray (2000)* Newly founded technology-oriented firms in the UK; the entry mode choice of high-tech start-ups can better be explained by an OC framework than by transaction cost or stage theory.	*Erramilli and Rao (1993)* US service firms, including software, banking, engineering firms, and hotels and restaurants; service firms choose their entry mode according to a modified TCA model that considers inseparability or capital intensity if relevant. A low-control entry mode is selected if the cost of integration rises and the firm's ability to integrate is limited.	*Brouthers et al. (1996)* US software firms; the probability of an integrated sales mode increases with a firm's ownership and/or locational advantages.

Source: own presentation.

might be very high and could exceed the cost savings of an integrated entry mode. If an inseparable service is sold abroad using an integrated sales mode, the service has to be produced abroad, requiring a resource-intensive investment in the foreign market (e.g., hotels or hospitals).

Neither the resource-based view of the firm nor the internationalisation process model was developed to account for the entry mode choice of service firms. However, whereas the notion of the

RBV and Madhok's organisational capabilities perspective of the firm are also appropriate to explain foreign sales modes of service firms, the internationalisation process model is less valid in service industries, especially in technology-oriented sectors. Bell (1995) claimed that there is only little empirical support for the view that software firms increase their engagement in one particular foreign market in small incremental steps. The growing commitment to exporting is expressed by an expansion into new destination countries rather than by an increasingly resource-intensive sales mode in one market. Sharma and Johanson (1987) demonstrated for a sample of Swedish technical consultancy firms that the latter bypass some of the incremental steps proposed by the stage models since "resource commitments are of minor significance" for them (Sharma and Johanson 1987, p. 28). Of course, there are services for which an international engagement might entail large-scale investments. For software and consultancy firms, however, comparatively cheap sales modes are available (e.g., transferring a digital document via the Internet), allowing firms to expand their engagement in a foreign market without a large-scale commitment of physical resources.

The main focus of this section is to examine how firms change their foreign sales mode over time. The internationalisation process model and the stage models describe a time-dependent sequence of sales modes where firms start with no regular exports and move step by step to more resource-intensive sales modes. This process is pushed ahead by experiential knowledge an exporter accumulates over time. The other theories do not explicitly deal with sales mode changes. However, the models' explanatory variables (firm-specific intangible assets, transaction costs, OLI advantages) might fluctuate and it might thus be optimal for a firm to change its sales mode and adjust its internationalisation strategy to changing conditions (Calof and Beamish 1995). Replacing the sales mode currently used is, however, not without cost. A firm has to consider the cost of switching. Moreover, choosing a sales channel requires an investment, e.g., an investment in a marketing campaign if an integrated sales mode is selected, or an investment in finding a good distributor or agent in the case of a non-integrated sales mode. Such investments might be regarded as sunk costs. Considering further that selecting an appropriate sales mode is a decision made under uncertainty, this induces an option value of waiting: Even if the currently used sales mode is not optimal according to a cost-benefit analysis, it might be best to retain the present sales mode in order to avoid (sunk) costs of switching back in the foreseeable future. This argumentation leads to a spell of inaction similar to the model of export market participation as developed by Roberts and Tybout (1997).[87] Thus, we expect to observe a relatively high persistence over time in the selected sales modes.

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[87] This phenomenon is known as "hysteresis" (Dixit 1989).

4.4.2   Descriptive Analysis

It is self-evident that a firm may use different sales modes in different foreign markets. In this section, I will analyse the changes of sales modes in an exporter's three most important foreign countries (in terms of their contribution to total sales). Therefore the descriptive analysis starts with a discussion of the geographical focus of our sampled firms' international business activities.

At the time of the first survey, UK-based exporters had sales in an average of just over 9 foreign countries, whereas German firms supplied 7 foreign countries on average. These numbers rose until the second survey in 2003 to 19 foreign destinations for UK firms and just under 12 foreign countries for German firms. Similarly, as discussed and econometrically examined in the previous section, both UK-based and German exporters were able to enlarge the share of foreign sales in their total sales. The average share of total turnover of UK (German) exporters generated by foreign sales rose from 39 % (24 %) in 1997 to 50 % (33 %) in 2003. Obviously, the degree of internationalisation, measured by the number of foreign countries entered as well as the share of foreign sales, was higher for UK-based exporters than for their German counterparts.[88] This was the case at the time of the first survey and remained valid, although both UK and German firms had on average intensified their international engagement. As Bürgel et al. (2004) argued, this might be the case because British exporters more pro-actively exploit the sales potential of foreign markets or because German firms are less dependent on the international market because of the larger size of their domestic market.

When entering their first foreign market, both German and UK firms were an average of three years old. In both countries, about one-third of the firms that have ever had international sales entered their first foreign market no later than one year after firm formation ("born globals"). There are, however, differences between German and UK firms with respect to the geographical focus of their first international market. The five most frequently stated countries where German firms had their first foreign sales were, in order of frequency, Austria, Switzerland, the Netherlands, the United States, and Belgium. Thus, German firms preferred neighbouring countries as their initial target countries, although the US market still occupied the fourth place for German firms. On the contrary, UK-based exporters most frequently indicated Germany, the United States, France, the Republic of Ireland, and the Netherlands. British technology-oriented start-ups obviously favoured countries with a large market potential. The nearest neighbour of the UK, the Republic of Ireland, only took the fourth place among the most popular initial markets. The differ-

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[88]   According to t-tests, the means for UK firms are significantly larger than the means for German firms. This is true for both measures and for both points in time.

ences between German and UK firms might again be due to the more pro-active behaviour of UK firms (see Bürgel et al. 2004). The latter firms operated a "push-strategy" (Andersson 2000), i.e., from their first international business activities they actively created the internationalisation process of their firm and exploited the sales potential of the foreign market. In contrast, the first international sales of German firms were often a result of an unsolicited order from abroad ("pull-strategy", Andersson 2000). This interpretation is supported by the fact that UK firms more often chose distant, non-European markets as their first target market as compared to German firms (in addition to the United States, e.g., Canada, South Africa, or Japan).[89]

Table 4-11: Geographical Focus of the Three Most Important Target Countries

	Germany		UK	
	1997	2003	1997	2003
EU 15 (incl. Norway, Switzerland, and Iceland)	67.63	70.27	54.07	48.37
Rest of Europe	10.79	7.03	4.78	3.25
NAFTA (USA, Canada, Mexico)	9.35	9.19	16.75	21.14
Latin America (without Mexico)	2.16	0.54	0.48	1.63
Asia	8.63	11.89	12.92	17.48
Australia	0.72	0.54	6.70	5.69
Africa	0.72	0.54	4.31	2.44
Total	100	100	100	100

Source: ZEW, University of Exeter, own calculation.

Beside their first target countries, the two surveys asked the sample's exporters to indicate the three most important countries (in terms of their contribution to total sales) where they had international sales. Aggregating these countries shows that countries from the European Union (15 member states, plus Switzerland, Norway, and Iceland [EU 15]) represented the main regional group for both German and UK-based firms (see Table 4-11).[90] Countries from the EU 15 were even more important for German than for UK firms. As in the case of the firms' first target countries, more distant markets were of greater importance for UK firms than for their German rivals. This is partly due to the more prominent role of English-speaking countries from the British Common-

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[89] In connection with the first survey conducted in 1997, 40 case studies (20 in each country) were carried out in order to illustrate the statistical findings of the large mail survey. The interviews, which are documented in detail by Bürgel et al. (2004), also support the interpretation that the internationalisation process of German firms can be described as a "pull-strategy", whereas UK firms rather follow a "push-strategy".

[90] Note that the unit of analysis for these figures is not the individual firm but the single country entered by the firm. Exporters that have international sales in only one country enter the figures in Table 4-11 once; exporters that indicated their three most important foreign markets contribute three observations to these figures.

wealth (Australia, South Africa, Canada). Essentially, the broader geographical focus of UK-based firms' most important target countries is a result of these firms' push-strategy as described above.

Comparing the regional distribution of each nation's three most important countries in 1997 and 2003, a similar pattern emerges between the two points in time. However, whereas the role of countries from the EU 15 had increased for German firms, the share of EU 15 member countries among the three most important destinations had fallen for UK firms. Moreover, for German firms, Asian markets became more prominent and the role of Eastern European markets decreased in return. For UK firms, the share of both North American and Asian markets increased. Obviously, UK firms continued to pro-actively exploit remote, non-European foreign markets and expand their position in those markets. The United States presented the single most important destination for UK firms both in 1997 and 2003. On the contrary, the most important country for German firms in 1997 was Austria; in 2003 this place was occupied by Switzerland. Neighbouring countries did not only play a dominant role as regards initial target markets. German exporters continued to prefer them even at a later stage of their internationalisation process. Large and distant markets were exploited to a lesser extent by German firms than by their UK-based rivals.

Referring to the three most important target countries, the first survey asked the firms' representatives to indicate the sales modes used to sell to these three countries, at the time of market entry and in 1997. The second survey also referred to the three most important markets the companies had identified in 1997. Firms were first asked whether they still had foreign sales in each of these countries. If this was the case, firms had to indicate the dominant sales channel they were currently using in each respective market in 2003. Thus, we arrived at a sequence of three foreign sales modes in each of the firms' most important foreign markets of 1997. Such a sequence is required since we are interested in explaining *changes* in foreign sales modes. Of course, the markets investigated may no longer represent the firms' most important markets of 2003. In fact, a good one-third of the foreign markets analysed lost this property between the two surveys.[91]

German firms most frequently used direct exporting to end-users as their entry mode in foreign markets (see Table 4-12). In contrast, foreign distributors that sell on a regular basis were the preferred entry mode for UK exporters. The more prominent role of direct exporting among German firms might reflect that they more often started exporting due to an unsolicited order from abroad before they had made any contractual agreement with a foreign distributor (pull-strategy).

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[91] The second survey also provides information on the sales modes in the firms' three most important markets of 2003 as they were summarised in Table 4-11. The distribution of sales modes used in these markets is similar to that shown in Table 4-12, although direct exporting is even more prominent for both German and UK firms.

Table 4-12: Sales Modes Used in Most Important Foreign Markets of 1997 (in %)

Sales Mode	Germany			UK		
	entry mode	1997	2003	entry mode	1997	2003
Direct exporting	42.31	35.77	47.31	37.81	30.57	35.71
Agents	11.54	12.20	5.38	10.95	9.84	13.49
Distributors	40.00	44.72	38.71	45.27	49.74	45.24
Sales joint venture	0.77	0.81	1.08	2.49	4.66	1.59
Wholly-owned subsidiary	0.77	2.44	3.23	1.49	3.11	3.97
Licensing	4.62	4.07	4.30	1.99	2.07	0.00
Total	100	100	100	100	100	100

Source: ZEW, University of Exeter, own calculation.

In contrast, UK exporters, who tended to pro-actively exploit the foreign market, more often began their international business activities based on a contractual agreement with a foreign partner (push-strategy). UK firms' relative preference for using an intermediary probably also reflects that UK firms' three most important foreign markets were relatively often remote, non-European countries, where a cooperation with a foreign partner might be particularly advantageous. Besides foreign distributors, foreign agents that sell ad hoc on a commission basis might also act as this kind of foreign partner. In a good 10 % of the most important foreign markets, both German and UK firms used foreign agents as their first entry mode. The literature on entry modes generally does not distinguish between agents and distributors. Both export intermediaries are assumed to possess local-market knowledge and crucial contacts with foreign customers. Moreover, finding good distributors or agents demands considerable efforts (see, e.g., Root 1987). Although it might be argued that firms have to choose efficiently between agents and distributors and that their choice might be affected by transaction-specific assets and production-cost economies (Bello and Lohtia 1995), this section follows most other studies and regards the two export intermediaries as one sales mode.[92]

Sales joint ventures and wholly owned sales subsidiaries were rarely chosen as the entry mode. These two entry modes constitute more resource-intensive modes than direct exporting or export intermediaries. Most of our sample's exporters probably did not possess enough resources to enter the foreign market via a sales subsidiary. This is true not only for the firms' entry modes but also for the sales modes used in 1997 and 2003. Although a slight increase in the share of markets

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[92] Adding up the percentages of agents and distributors reveals that for German exporters, as for their British counterparts, export intermediaries comprise the most frequently used entry mode. However, direct exporting remains more prominent among German firms than among UK firms.

where the firms used a sales subsidiary could be observed, these resource-intensive sales modes continued to be of minor importance. Therefore, they are neglected in the following.

Licensing as a foreign market entry mode is commonly defined as a contractual agreement where the domestic firm (licensor) provides a foreign company (licensee) with intangible assets or property rights in return for payment (Root 1987, p. 85). In general, licensing is discussed in the context of foreign production of manufacturing firms as opposed to foreign direct investment (FDI). This sales mode, however, is almost irrelevant for our sample. Only one manufacturing firm indicated licensing as its sales mode. The firms that indicated licensing as displayed in Table 4-12 were software firms that sold licenses for the use of their software programmes to foreign companies and end-users. In the following, licensing will be neglected as well, since the firms in our sample again rarely chose it as their dominant sales mode in their foreign markets.

In 1997, exporting via an intermediary (agents and distributors) was used in more than 50 % of the firms' most important foreign markets as the dominant sales mode. In comparison, the share of foreign countries that were served via direct exporting decreased for both German and UK firms. Some firms that had first entered a foreign market with direct exports changed their sales mode to exports via an intermediary before 1997.[93] If the initial stimulus to start an international engagement on a foreign market was an unsolicited order, firms might have first supplied their new foreign customer on that market by a direct export. Later, firms might have raised their commitment on that market by making a contractual agreement with a foreign distributor or agent. Thus, changing from direct exports to an intermediary can be regarded as an increased commitment of resources as predicted by the internationalisation process model (Johanson and Vahlne 1977, 1990). However, exporting via an intermediary is not necessarily more resource-intensive than direct exporting. If direct exporting means selling standardised products or pre-packaged software via the Internet (business-to-business or business-to-consumers e-commerce) transaction costs will fall below those of selling via a foreign distributor or agent (e.g., costs for finding and controlling the foreign intermediary). In fact, the share of firms that used direct exporting is significantly higher for our sample's software firms than for manufacturing firms. If, however, the firm sells a product that requires close contact with end-users (because of individual client customisation or intense technical consultation prior to sales, for instance), direct exporting will turn out to be highly resource-intensive. In this case, transaction costs could well be reduced by a foreign inter-

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[93] The number of observations in the two columns "entry mode" and "sales mode in 1997" are almost identical, since the information for both was given in the first survey conducted in 1997. The minor deviation in the number of observations is only due to some item non-responses. Changes in the share of entry modes in the two columns, therefore, result from firms changing their sales mode in one market or another.

mediary.[94] Thus, whether exporting via an intermediary comprises a more resource-intensive sales mode than direct exporting or vice versa depends on a firm's product characteristics. Similarly, a change of sales mode from direct exporting to an intermediary may or may not mean a more resource-intensive commitment to the foreign market. However, young and small technology-oriented firms might still be forced to use a foreign distributor or agent as their sales mode in order to overcome what Bürgel et al. (2004) called the "liability of alienness". Customers might not trust an unknown foreign supplier which is, as in the case of a born global, not even established in its own domestic market. Thus, using an intermediary might be the only way for a young high-tech firm to sell on a foreign market.

Taking this into account, it is rather surprising that between 1997 and 2003 some firms changed their dominant sales mode from using an intermediary to direct exporting.[95] German firms in particular increased the share of foreign markets where they used direct exports so that in 2003 this sales mode was more prevalent than exporting via an intermediary. The share of foreign markets where UK firms sold their products via direct exporting also rose between the two surveys, although intermediaries remained their most frequently used sales mode. The regained importance of direct exporting might have several reasons. Generally speaking, firms decide on a change of their sales mode based on a cost-benefit analysis. Thus, they will change to direct exporting if they can reach a given benefit (e.g., a desired foreign market penetration) with lower (transaction) costs, or if direct exporting results in a higher benefit at given costs.[96]

The cost-benefit trade-off might have altered between 1997 and 2003 for a number of reasons. Firstly, the sample's exporters might have become established suppliers on their foreign markets, reducing the liability of alienness and thus the necessity of using an intermediary. Secondly, the

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[94]   Note that this argumentation contradicts the propositions of Anderson and Gatignon (1986) as reviewed in section 4.1. The latter assumed that transaction costs of selling a technically sophisticated product via an intermediary (low-control sales mode) exceed those of direct exporting (high-control entry mode), in particular because of the high costs of controlling a potential intermediary. In contrast, I argue that in the presence of transaction-specific assets the costs of controlling a foreign distributor rise as proposed by Anderson and Gatignon, but that the costs of direct exporting also increase tremendously. Thus, the costs of exporting via an intermediary may or may not exceed the costs of direct exporting.

[95]   The number of observations in the column "sales mode in 2003" is smaller than in the first two columns of Table 4-12. German firms left a good 18 % of their three most important markets of 1997 between the two surveys, UK firms left a good 9 %. Thus, the shares of sales modes used in 2003 differ from the 1997 column because firms left certain markets and because they changed the sales modes used on the foreign markets where they still had international sales in 2003.

[96]   During the time period we observe, the majority of the firms in our sample switched their sales mode just once. There are a few markets where the sales mode was changed twice. Whenever this was the case, the sales mode first changed from direct exporting at the time of market entry to exporting via an intermediary in 1997, and then back to direct exporting in 2003.

investigated market might no longer belong to the firm's most important markets in 2003. Assuming that exporting via an intermediary is the more resource-intensive sales mode, a small firm might have reallocated its limited resources to its currently most important markets in order to build up new relationships with local distributors or agents. On the remaining, currently less important markets an exporter might restrict itself to serving its occasional customers by direct exports. Further, an exporter might have altered the innovativeness of its products. In fact, the share of exporters of which the product incorporated novel, self-developed technology had increased from 34 % in 1997 to 48 % in 2003. In return, the share of exporters that used a "tried and tested" technology decreased from 40 % to 21 % during that period. According to the theories reviewed, a higher degree of innovativeness should increase the firms' inclination to use a sales mode with a higher level of control, i.e. in our case, direct exports. Finally, firms might also have changed to direct exporting because the (relative) transaction costs of this sales mode decreased between 1997 and 2003. For example, electronic commerce (e-commerce), by which the costs of cross-border transactions can be reduced, became more and more widespread in both Germany and the UK.[97] [98] If direct exporting became relatively cheaper than exporting via an intermediary, this should have made a change more likely.[99]

Table 4-13 shows in how many markets firms chose a particular sales mode, given the sales mode they had used in the previous period. Although switching is relevant, we observe high persistence in the sales mode utilised. In more than 80 % of the firms' export destinations, the selected sales mode remained unchanged in the following period (observations on the main diagonal). This might be explained by the existence of sunk costs (e.g., the costs of finding a good intermediary) similar to the model of export market participation developed by Roberts and Tybout (1997) and in

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[97]   There are only a few reliable and internationally comparable figures for the application of e-commerce. OECD (2003) uses the number of SSL-servers (secure socket layer) as an indicator for the potential of e-commerce, because SSL-servers are needed for business transactions via the Internet that require the transmission of confidential data, in particular in the case of electronic payment. The number of SSL-servers per 100,000 inhabitants increased remarkably during the last years: Whereas in 1998 there were 0.6 (1.2) SSL-servers per 100,000 inhabitants in Germany (in the UK), the number rose to 9.7 (17.2) in 2002. According to a ZEW survey, 39 % of all German companies with at least 5 employees utilised the Internet for e-commerce activities in 2002 (Hempell 2004).

[98]   Fritz (2000) analysed how international market entry strategies will change if the possibilities of the Internet economy are taken into account.

[99]   Nakamura and Xie (1998) derived a Nash bargaining solution for the bargaining process between a multinational firm and its local partner. The Nash bargaining ownership share in a joint venture (i.e., the level of control) depends on the bargaining power of the two partners. In accordance with this model, it might be argued that our sample's high-tech firms have only relatively little bargaining power, since they are small and, at least in 1997, were forced to make a contractual agreement with a foreign intermediary due to the liability of alienness. Thus, contractual agreements our sample's firms made in 1997 might have been unfavourable for them, causing them to be interested in changing to direct exporting if possible.

accordance with the theoretical considerations in section 4.4.1. In just under 16 % of foreign markets where direct exporting was used as the dominant sales mode in the previous period, firms changed to exporting via an intermediary in the following period. As described above, this transition (not exclusively but) primarily occurred in the period between the foreign market entry and the 1997 survey. A transition from exporting via an intermediary to direct exporting was observed in just under 10 % of export destinations that were supplied via an intermediary in the previous period. Such a transition took place primarily in the period between the two surveys. Changes from and to other sales modes were numerically unimportant and will therefore be neglected. The econometric analysis thus concentrates on the upper-left four-field transition matrix in order to find out what factors influence the probabilities of a transition from direct exporting to exporting via an intermediary and vice versa.

Table 4-13: Changes of Sales Modes in Firms' Most Important Foreign Markets of 1997

	n %	Sales modes t			Total
		Direct exporting	Intermediary	Other sales modes	
Direct exporting		146 81.11	28 15.56	6 3.33	180 100
Exporting via an intermediary		30 9.74	266 86.36	12 3.90	308 100
Other sales modes		8 22.86	4 11.43	23 65.71	35 100
Total		184 35.18	298 56.98	41 7.84	523 100

(Left axis label: Sales modes t-1)

Other sales modes: sales joint venture, wholly owned subsidiary, licensing.
Source: ZEW, University of Exeter, own calculation.

4.4.3 Econometric Implementation

Examining the probability of a transition from one sales mode to another or the same sales mode in the next period, I apply the same model used for estimating foreign market entry and exit (i.e., the transition probability between different states of export market participation) in section 4.2 (cf. Gouriéroux 2000 and Van et al. 2004). Since our sample's exporters were asked to indicate the sales mode used in their three most important foreign destination countries of 1997, the individual observation i is not the exporter but the sales mode used by the exporting firm in one particular foreign market.

Let Y_{it} denote the sales mode j used in a particular market in time t, with $Y_{it} = 1$ if the exporter has chosen direct exports and $Y_{it} = 0$ otherwise. As before, the transition probabilities are modelled with the logistic formulation and depend on a set of explanatory variables. The probability of transition from sales mode j in t-1 to sales mode j' at time t is then given by

$$(4.22) \quad P_{ijj'}(t) \equiv P(Y_{it} = j' | Y_{it-1} = j) = \frac{\exp(x_{it}\beta_{jj'})}{\sum_{j'=0}^{1} \exp(x_{it}\beta_{jj'})},$$

$i = 1, \dots, N$, $t = 0, 1, 2$, and $j, j' = 0, 1$. Thus, a logit model is specified for each row of the transition matrix (for more details see section 4.2.3).[100]

As Johanson and Vahlne (1990) proposed, large firms are able to use a more resource-intensive sales mode, assuming that size is a proxy for the firm-specific assets a company has at its disposal. Further, Johanson and Vahlne argued that uncertainty prevalent on a foreign market can be reduced by hiring an internationally experienced manager. The econometric model operationalises firm size as the logarithm of the number of employees at time t. International experience is measured by a dummy variable taking the value 1 if the firm's representatives indicated that a member of the firm's management team had work experience abroad, had previous work experience in the domestic country for an international company, or if a manager was educated abroad before joining the company. According to Johanson and Vahlne, these two variables should be positively correlated with a change to a more resource-intensive sales mode. However, as discussed in the previous subsection it is not clear, a priori, whether direct exporting is more resource-intensive than exporting via an intermediary or vice versa. Thus, it is not possible to hypothesise which sign these two variables are expected to take based on the internationalisation process model. It might, however, be argued that a higher amount of physical resources, approximated by firm size, enables the firm to bear the high switching costs of a sales mode change. This argument speaks in favour of a positive sign of firm size in each of the two transition equations.

The firm managers' international experience can also be regarded as constituting an intangible asset decisive in determining firms' internationalisation behaviour from a resource-based view of the firm, or as an ownership advantage in Dunning's eclectic framework. Finally, international experience can reduce internal uncertainty and thereby increase the probability of switching to a

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[100] Since the transition from a distributor to direct exports can be regarded as a rare event in our data set, I also estimated the respective transition probability using a rare event logit, as also used when estimating the probability of an exit from foreign market in section 4.2. The results, however, do not change, so in the following I will restrict myself to using a conventional logit model.

high level of control, i.e., a more integrated sales mode like direct exporting as predicted by Anderson and Gatignon's (1986) transaction cost analysis theory.

According to the resource-based view, a firm distinguishes itself from its competitors by its intangible and inimitable assets. Those assets are generated by conducting R&D activities and are reflected by the innovativeness of the firm's products and services. Instead of considering R&D intensity in the econometric model, I will include a dummy variable in the regression equation that indicates whether a firm carried out permanent R&D activities at the time of the surveys. This variable better describes the firms' long-term R&D activities and is therefore probably more suitable for explaining the probabilities of a sales mode change, since there is a six-year interval between the two surveys.[101] Further, the firm's innovativeness is approximated by the dummy variable reflecting novel and self-developed technology incorporated into the firm's best-selling product or service. Both the organisational capability perspective and the transaction cost theory propose that a high-control sales mode (e.g., direct exporting) will be selected if the firm possesses intangible, inimitable assets, or if the firm's product is technically sophisticated. Hence, the two variables are both hypothesised to lower the probability of switching from direct exporting to exporting via an intermediary, and to increase the probability of a change from using a foreign distributor or agent to direct exports.

A high level of R&D activities is typical of technology-oriented firms like those examined by this study. Moreover, today's high-tech markets are characterised by shrinking product life cycles. The time span during which a high-tech firm can exploit its technological advantage is therefore limited (cf. Sampler 1998). Interviewing the firms in our sample, we asked firm representatives to estimate the time a competitor would need to launch either a similar product with superior performance or a product with similar performance at a lower price. Bürgel et al. (2004) called this competition-free time period when firms can realise temporary monopolistic rents the "window of opportunity". I will include a dummy variable in the estimation equation taking the value 1 if the estimated window of opportunity is one year or shorter. Malhotra et al. (2003) proposed that a short window should increase the probability of selecting a low-control sales mode in order to exploit the technology in the shortest time (see also Bürgel and Murray 2000). However, if a firm has to replace its product line at least once a year, the sales personnel of the foreign partner will have to be trained annually. Especially in the case of a technically sophisticated product where the transfer of knowledge to an intermediary is difficult, the costs of exporting via a distributor or

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[101] Replacing the firm's R&D intensity by the dummy variable indicating permanent R&D activities already proved to be appropriate when estimating the firm's degree of internationalisation in the previous section.

agent will rise. It is questionable whether these costs can be amortised within the time span of a very short window. Therefore, I hypothesise that in the case of a short window of opportunity a firm is more likely to remain a direct exporter. Similarly, a firm is more likely to change to direct exports if it used an intermediary in the previous period. The econometric analyses will decide which of the two conflicting hypotheses, by Malhotra et al. (2003) and myself, better describes the sales mode selection of high-tech firms.

In addition to the technology incorporated into a firm's product or service, the transaction costs and thus the desired level of control might also be influenced by the necessity for close contact with key customers. According to Anderson and Gatignon (1986), a higher level of control will be preferred if intense product customisation is prevalent. For the econometric estimations, a dummy variable will be used taking the value 1 if the firm classified the requirement of customisation as "important" or "very important". If customisation is important, the probability of changing to an intermediary should decrease, while switching to direct exporting should be more likely. Moreover, the logit regressions contain a dummy variable that indicates if the product or service is directly sold to end-users, and a further dummy variable if the firm sells business services to other companies. The base category is a firm selling manufactured goods to other companies (either as a component or as an investment good). Selling a product or service directly to a probably large number of end-users is personnel-intensive, but is often a matter of routine business that can easily be handled by an intermediary (e.g., a foreign retailer). In contrast, selling to other companies is often practised via personal contact to the other firm's purchasing department so that direct exporting will be preferred, in particular, if the exporter only has a limited number of key customers.[102]

The role of target country-specific factors is underlined by the transaction cost theory and by the locational advantages of Dunning's eclectic paradigm. Moreover, the internationalisation process model emphasises the importance of experiential knowledge acquired in one particular target market for the selection of the appropriate sales mode. Our model measures the country-specific experience by the (logarithm of) years a firm has had international business activities in the particular country since market entry.[103] According to the transaction cost model of Anderson and

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[102] Anderson and Gatignon (1986) further proposed that the probability of using a high-control sales mode will increase if the firm sells an immature product. I estimated a specification that included (the logarithm of) the age of the firm's best-selling product, but this variable turned out to be insignificant in both transition equations and was therefore excluded from the final specification.

[103] Since we observe the firms in our sample only at the time of the two surveys, i.e. in 1997 and 2003, it cannot be excluded that a firm may have left and re-entered a particular foreign market between the two surveys. Thus, the number of years used in the regression models is, strictly speaking, only correct in the case of a continuous engagement in a foreign country.

Gatignon (1986), a lack of international experience leads to a low-control sales mode, i.e. to exporting via an intermediary. Furthermore, the model includes the target country's market potential, approximated by (the logarithm of) the target country's GDP and the rank of country risk.[104] It is difficult to predict how sales mode selection is affected by target market size. On the one hand, establishing one's own distribution network for direct exporting in a large country is rather resource-intensive. On the other hand, a country with a large market potential is attractive and firms might invest in that country in order to pro-actively exploit its market potential. Therefore, I will follow Barkema and Vermeulen (1998) and Bürgel and Murray (2000) and include the absolute size of target country as a control variable without formulating any hypothesis regarding the expected sign. Hence, the effect of market size, if any, will be determined econometrically.

The transaction cost theory argues that country risk increases the probability of choosing a high-control sales mode only in *combination* with transaction-specific assets. Hence, I calculated two interaction variables by multiplying the country risk variable with the two dummy variables that represent the intangible assets incorporated into the firm's best-selling product or service. The first interaction term is thus the product of country risk and the dummy variable that indicates whether a firm carries out permanent R&D activities; the second interaction variable is the product of country risk and the dummy denoting that novel and self-developed technology is incorporated into the firm's product or service. To control for an independent effect of country risk on the probabilities of sales mode change, i.e., without an interaction with transaction-specific assets, the rank of country risk is included individually in the regression equations.

The sales mode used in a foreign market might also depend on the importance of that market, measured in terms of the country's contribution to total sales. If a firm generates only a relatively small share of total sales in a particular foreign country, for example, due to some occasional orders from that country, the firm might not be willing to commit a high amount of resources to finding and training a foreign distributor or agent. In this case, occasional direct exports might be optimal. Conversely, in a target market that makes important contributions to the firm's total sales, a resource-intensive sales mode might be selected.[105] Unfortunately, the share of total sales generated by each target country is only available in the data set for the first survey and not for the second survey. In the second survey, firms were asked instead to indicate the percentage of total

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[104] The data sources of target countries' GDP and risk are described in detail in appendix A.1. Country risks were ranked and then entered into the model. Rank "1" was attributed to the lowest risk level.

[105] As already argued above, it is difficult to decide whether direct exporting or exporting via an intermediary is the more resource-intensive sales mode. Thus, it is not possible to hypothesise which sign is expected in the regression equations.

sales generated in the regions given by Table 4-11. Hence, I used the share of total sales generated in the region the target country belongs to in order to approximate the importance of the particular market for the firm.[106]

Finally, I will include three dummies as control variables in the regression equations. The first dummy variable takes the value 1 if the exporter is sited in Germany. As the descriptive analysis in Table 4-12 shows, distributors and agents were more frequently used by UK-based firms in their three most important target countries of 1997. Moreover, given that at time t-1 direct exporting was used, UK-based firms more often switched to exporting via an intermediary at time t than German firms. On the other hand, German and UK firms changed from an intermediary to direct exports in a comparably high share of foreign markets. The econometric analysis will show whether these disparities in the descriptive statistics can be explained by our model, or whether there are unobservable differences between German and UK-based exporters. In contrast to the analyses of both foreign market entry and exit and the firms' degree of internationalisation, this section's model will not contain an additional dummy variable indicating firms that are located in Eastern Germany, because the absolute number of sales mode changes is very small in the sub-sample of Eastern German exporters (only three changes from direct exports to exporting via an intermediary and three changes in the opposite direction). Thus, a dummy variable indicating Eastern German exporters would almost perfectly predict "failure" (read: non-change) and will therefore be neglected in this section's econometric model.[107]

The descriptive analysis in section 4.4.2 further showed that service firms more often used direct exporting as their dominant sales mode than manufacturing firms. Therefore, two industry dummy variables will be added. The first industry dummy variable characterises firms that belong to an engineering industry; the second dummy variable indicates firms from other manufacturing sectors, including ICT-hardware and health and life sciences. Thus, service firms are used as the base category.

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[106] Data from the first survey were appropriately aggregated in order to obtain comparable data for both periods examined.

[107] The main reason for the small number of changes observed is the significantly lower probability of Eastern German firms having international sales, reducing the number of Eastern German exporters. The number of foreign markets entered by Eastern German exporters is also smaller than the respective number for Western German firms, however not significantly so (2003: Western German exporters: 12 countries, Eastern German exporters: 10 countries). After entering into the foreign market, the export behaviour of Eastern German firms is similar to that of their Western German counterparts. This interpretation is supported by the econometric result that Eastern German firms do not have a significantly higher probability of leaving the foreign market and by the descriptive result that in 2003 the average degree of internationalisation of Eastern German exporters is no longer significantly smaller than that of exporting Western German firms (see Table 4-5).

4.4.4 Empirical Results

The results of the empirical model are given in Table 4-14. The second column shows the vector of coefficients $\hat{\beta}_{10}$, explaining the sales mode change from direct exporting at time t-1 to exporting via an intermediary at time t. The third column includes the vector $\hat{\beta}_{01}$ for a change in the opposite direction, i.e., from an intermediary to direct exports.

The country-specific dummy variable is insignificant in both transition equations. Thus, the fact that UK-based firms more often changed to exporting via an intermediary when they had used direct exporting in the previous period can be explained by our model. Manufacturing firms are more likely to change from direct exporting to exporting via an intermediary than service firms. Moreover, the probability that an engineering firm will keep on selling its products via a foreign distributor or agent if it had already used this sales mode in the previous period is higher than for other manufacturing and service firms. These results coincide with the findings of the descriptive analysis that service firms more often use direct exports as their dominant sales mode. For our sample's service firms (mainly software firms) direct exporting probably constitutes a relatively cheap sales mode since they can distribute their digital services directly via the Internet. Surprisingly, engineering firms differ from other manufacturing firms in their lower probability of switching to direct exports. There are possibly additional industry-specific costs that have to be borne by engineering firms, costs that are not captured by the variables of our model. If establishing business relations with a foreign intermediary is more expensive for an engineering firm than for other manufacturing firms, i.e., if the sunk costs an engineering firm has to pay exceed those of other firms, the engineering firm will more likely continue to sell its product via an intermediary. In the presence of sunk costs an engineering firm will keep on exporting via an intermediary in order to avoid (possible) costs of switching back, even if the use of an intermediary is currently not optimal. Interestingly, when analysing export market participation of our sample's firms in section 4.2.4, arguments were likewise found that foreign market entry of engineering firms is linked to higher industry-specific sunk costs in comparison to other manufacturing firms. Engineering firms showed a lower probability of entering the international market, but a higher probability of staying in the foreign market once they had entered. These differences can be explained by the existence of high industry-specific sunk costs. If there are sunk entry costs, engineering firms tend to avoid (possible) re-entry costs by staying in the international market, even if this is currently not optimal.

Firm size, measured by the number of employees, does not affect the probability of a change from direct exports to exporting via an intermediary. Interpreting size as representing the firms' finan-

Table 4-14: Propensities of Sales Mode Changes – Results of Logit Models

	Sales mode change direct exports → intermediary			Sales mode change intermediary → direct exports		
	Number of observations = 130			Number of observations = 242		
	LL = -41.033			LL = -46.699		
	χ²(17) = 29.71			χ²(17) = 40.28		
	Prob > χ²(17) = 0.029			Prob > χ²(17) = 0.001		
	McFadden's R² = 0.355			McFadden's R² = 0.419		
	Coeff.	*Robust stand. error*		*Coeff.*	*Robust stand. error*	
Country	-0.272	0.771		0.907	0.698	
Engineering	4.000	1.492	***	-2.206	1.072	**
Other manufacturing industries	3.238	1.316	**	-0.235	0.891	
Log (number of employees)	0.090	0.255		1.043	0.426	**
International experience of management	1.026	1.000		2.354	1.315	*
Permanent R&D activities	0.857	0.813		-0.797	0.621	
Interaction (country risk * perm. R&D)	-0.096	0.040	**	-0.023	0.043	
Novel, self-developed technology	-0.232	1.426		2.016	0.859	**
Interaction (country risk * novel tech.)	-0.006	0.064		-0.055	0.045	
Window of opportunity ≤ 12 months	-2.175	0.793	***	1.077	0.535	**
Intense product customisation	-1.171	0.593	**	0.860	0.695	
Consumer good	2.212	0.730	***	-1.211	0.690	*
Business service	1.303	0.866		3.272	0.977	***
Log (years since entry into target country)	1.233	0.590	**	3.802	1.120	***
Log (GDP of target country)	-0.043	0.310		-0.305	0.247	
Rank of country risk 1998	0.053	0.049		0.040	0.023	
Share of total sales generated in the target country's region	-0.016	0.020		-0.008	0.041	
Constant	-6.548	2.223	***	-14.565	4.412	***

* 10 % level of significance; ** 5 % level of significance; *** 1 % level of significance.

Base category: entry of a UK-based software/service firm.

Source: own estimation.

cial or physical resources, this is an interesting result. It corresponds to the findings of Bürgel et al. (2004) who estimated a probit model for the exporters' decision on entry mode (the first sales mode used in a particular target country), using the cross-sectional data set of the first survey. They found that (the logarithm of) start-up size has no effect on choosing a distributor as the first sales mode.[108] As pointed out in section 4.4.2, a change from direct exporting to exporting via an intermediary was (not exclusively but) primarily observed in the period between foreign market entry and the 1997 survey. Thus, identifying and forming commercial relationships with a foreign partner requires so few additional resources that they can be raised even by the small, high-tech

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[108] For the subsample of UK-based firms, Bürgel et al. (2004) found a positive effect of start-up size on the probability of selecting a distributor, however only at the 10 % level of significance.

firms of our sample during their start-up period and the early stage of their international engagement. On the contrary, replacing exporting via an intermediary by direct exports is facilitated if the firm has large financial or physical resources at its disposal. The coefficient of firm size is positive and significant in the transition equation. Finishing the cooperation with a foreign partner and establishing one's own distribution network for direct exporting can thus be interpreted as a more resource-intensive commitment to a particular market – at least for manufacturing firms.

The influence of the management's international experience goes in the same direction as that of firm size. While it does not have any effect on switching to an intermediary, it supports a change to direct exports. Internationally experienced managers are less reliant on a foreign partner. However, the managers' international experience does not prevent a firm from being forced to use an intermediary during an early stage of its international engagement. Regardless of any international experience, firms that have entered the foreign market by direct exports have the same probability of changing to an intermediary, possibly in order to overcome the liability of alienness.[109]

Two dummy variables were intended to measure the firms' intangible and inimitable assets: a dummy variable indicating permanent R&D activities and another dummy indicating whether novel and self-developed technology was incorporated into the firm's best selling product or service. These two variables were hypothesised to increase the probability of using a high-control sales mode, i.e. direct exports. Permanent R&D activities do not have any individual influence on the transition probabilities. There is only a slightly significant negative effect of the interaction term with the country risk variable. Moreover, the prevalence of novel and self-developed technology only raises the probability of switching from an intermediary to direct exports, having no effect on the transition in the other direction. The signs of the significant variables thus correspond to the predictions of the transaction cost theory and the organisational capability perspective. Nevertheless, the transition probability from exporting directly to exports via an intermediary seems to be rather independent of the firm's intangible and inimitable assets. In fact, the marginal effect of the interaction term is relatively small. Setting all variables to their means, the interaction term decreases the probability of a change from direct exports to an intermediary by less than one percentage point.[110] Similarly to the firm managers' international experience, it might be argued that during an early stage of the firm's international engagement, intermediaries are a prerequisite

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[109]   According to Bürgel et al. (2004), international experience of the management team increases the probability of choosing direct exports as foreign market entry mode. My results show that even if a firm entered the target country by direct exports it is sometimes compelled to change to an intermediary, e.g., because of the liability of alienness. If this is the case, international experience cannot prevent an exporter from taking this step.

[110]   The marginal effects of the logit regressions will be discussed in greater detail below.

for selling abroad in order to cope with the liability of alienness. Firms that had entered the foreign market by exporting directly were forced to find a foreign partner, regardless of the technology and the degree of innovativeness incorporated into their product and even if the choice of an indirect sales mode was not optimal from a transaction cost point of view.

After becoming established in the foreign market, firms are able to select the sales mode that minimises transaction costs or that is best suited to the firms' intangible resources. Thus, the technology incorporated into the firms' products is more important for explaining a change from an intermediary to direct exports.[111] However, switching from exporting via an intermediary to direct exports cannot exclusively be interpreted as a change from a formerly suboptimal sales mode (from a transaction costs point of view) to an optimal one during a later stage of the firm's international engagement. This interpretation is only one possible scenario. Alternatively, choosing an intermediary during an early stage of the firm's export activities might have been perfectly optimal, because at the time of the first survey the exporter was producing its product using a "tried and tested" technology. The transaction cost theory and the organisational capability perspective suggest that in this case a low-control sales mode (i.e., an intermediary) is preferred. However, 40 % of the exporters that were using a "tried and tested" technology at the time of the first survey changed to a novel and self-developed technology in the period between the two surveys. Thus, switching from an intermediary to direct exports was necessary because the exporter increased the degree of innovativeness of its product.

Interestingly, the dummy variable representing permanent R&D activities is not correlated with the probability of such a transition. This might be due to the fact that R&D constitutes an input variable and may not necessarily reflect the product's transaction-specific assets. It may be that firms carry out R&D not to realise product innovations, but rather to make process innovations. The latter may lead to cost reductions and, as a consequence, to lower prices and improved competitiveness of the firm's product. Therefore, R&D activities may be able to explain the decision to internationalise, but may not have an impact on the sales mode chosen. In fact, analysing foreign market participation of the firms in section 4.2, R&D activities proved able to discriminate between exporters and non-exporters. However, as we have seen, they cannot explain changes of sales modes.[112] More suitable for measuring transaction-specific assets is the dummy variable

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[111]   Recall that a change from an intermediary to direct exports primarily occurred between the surveys conducted in 1997 and 2003, that is, during a later stage of the firms' export activities.

[112]   Estimating the determinants of entry mode choice for the firms in our sample, Bürgel et al. (2004) found a significantly negative effect of R&D intensity on the probability of choosing a distributor. However, the reported marginal effect is very small: A marginal increase in R&D intensity reduces the probability of using a distributor as the first sales mode by only 0.3 percentage points.

indicating novel and self-developed technology incorporated into the firms' products. This variable is presumably closely related to the technological characteristics of the products, since it directly reflects what firm managers said about their products.

As I hypothesised, a short window of opportunity decreases the probability of changing from direct exports to an intermediary and, conversely, increases the chance of switching in the reverse direction. Contrary to the hypothesis of Malhotra et al. (2003), high-tech firms that have to exploit their technological advantages in a very short period of time favour direct exports. If technically sophisticated products are replaced or upgraded at least once a year, this will require, among other things, expensive training of foreign distributors or agents which raises the costs of exporting via a distributor or an agent. In this case, exporting directly is preferred by a technology-oriented firm, even though it has to relinquish its foreign partners' knowledge of the local markets and their close contact with potential foreign customers. The impact of a short window of opportunity might also be interpreted from Madhok's organisational capability perspective (cf. Madhok 1997). The notion of the OC perspective is that a firm exploits its competitive advantage in order to generate revenues in a foreign market. The empirical results show that if the time period for exploiting a competitive advantage is limited, an integrated sales mode will be optimal.

The requirement for intense product customisation acts as a barrier to initiating exports via an intermediary. Customisation demands close contact with individual customers. Thus, the costs of selling abroad could, on the one hand, be reduced by a foreign distributor who is assumed to already have close contact with potential customers. On the other hand, customisation increases the costs of controlling the foreign partner. Moreover, Anderson and Gatignon (1986) argued that in the presence of substantial product customisation, exporters rely heavily on their relationships with probably only a limited number of key customers, leading to their interest in controlling these important relationships. Our results are consistent with the latter interpretation. Changing from direct exports to an intermediary is less likely if individual client customisation is prevalent. However, the dummy variable indicating intense customisation is not significant in the second transition equation. Once an exporter has chosen a foreign intermediary, the probability of changing the distribution channel is unaffected by the degree of customisation. Finding a foreign distributor and making a contractual agreement with it might be regarded as a sunk investment. Especially if customisation is important, such an investment might be relatively high, implying that switching from an intermediary to direct exports is observed less frequently than in the absence of sunk costs. This could possibly explain the insignificant effect of product customisation on the transition probability from exporting via an intermediary to direct exports.

Consumer goods or services that are directly sold to end-users are generally distributed to the foreign market via an intermediary. Even if the firms have entered the foreign market by direct exports, for instance, because they received an unsolicited order from abroad, it is likely that they will try to find an appropriate intermediary – at least if they intend to expand their international engagement. Similarly, it is less likely that a firm producing a consumer good will switch to direct exports if it is currently using an intermediary. Distributing a consumer good to a large number of end-users is often a matter of routine business, making a foreign distributor preferable. Comparing companies that produce a consumer good with firms that sell their products and services to other firms (either as a business service, an intermediate or an investment good), our results show that for the latter firms, the probability of changing from direct exports to an intermediary is lower and that switching from an intermediary to direct exports is more likely. The probability of changing to direct exports during a later stage of the firm's international engagement is even higher for business service firms than for manufacturing firms selling intermediate or investment goods (the base category), perhaps because e-commerce became more widespread in the period between the two surveys, offering software firms a relatively cheap way of distributing their services abroad.

The number of years a firm exports its products to a particular target market is assumed to be positively correlated with the use of direct exports. The longer a firm is engaged in a particular market, the more experience it is able to gain, allowing its ability to export directly to increase. It is also no longer necessary for the exporter to rely on the knowledge of a foreign partner. In fact, the number of years the exporter is engaged in the target country has a positive effect on the probability of a transition from exporting via an intermediary to direct exports. However, the coefficient of this variable is also significantly positive in the second transition equation, which contradicts the theory and is inconsistent with the positive result in the other equation. The number of years a firm sells its products in a target country probably does not really measure the experiential knowledge acquired by the exporter. Instead, the two positive coefficients might be interpreted in the sense that changing the dominant sales mode in a country is more likely the longer the firm is engaged in that country. Or in other words, it takes time to make a change. Binding contracts a firm has entered into with a foreign customer or a foreign distributor can make an early replacement of the sales mode used impossible.

The remaining target country-specific variables that were included in the regression equations are neither individually nor jointly significant.[113] The target country's GDP was included as a control

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[113] Wald tests of joint significance of the three remaining country-specific variables: transition from direct exports to exporting via an intermediary: $\chi^2(3) = 3.17$, $(\text{Prob} > \chi^2) = 0.366$; transition from exporting via an intermediary to direct exports: $\chi^2(3) = 4.48$, $(\text{Prob} > \chi^2) = 0.215$.

variable measuring the attractiveness of a foreign country. Although the descriptive analysis revealed that market potential is important for the selection of the exporter's target countries, in particular for UK-based firms that pro-actively exploit the potential of foreign markets, it is not relevant for changes in the sales modes used. According to Anderson and Gatignon (1986), country risk influences sales mode selection only in combination with transaction-specific assets. This proposition can be confirmed by our results. The rank of country risk has no significant effect in the two regression equations, but, as discussed above, the interaction term with permanent R&D activities decreases the probability of a transition from direct exports to exporting via an intermediary, although the effect is relatively small. Finally, the share of total sales generated in the region of the target market entered cannot explain why exporters change their sales modes either. The latter variable was intended to measure the importance of the particular target market for the exporting firm. Admittedly, this measure is rather vague, especially because the second survey contains only aggregated information about the share of total sales generated in several regions and none about the shares in the individual target markets. Moreover, the share of total sales might be endogenous since it can be regarded as a measure of the exporter's success in a country, which in turn might be influenced by the selected sales mode. Thus, it is impossible to say whether the variable proved to be insignificant because it is not suitable to measure the importance of a particular target country or whether a sales mode change is, in fact, independent of country-specific variables and can better be explained by firm-specific or transaction-specific assets.

In order to get further insights into how the individual variables affect the probability of switching to another sales mode, I calculated marginal effects. It is well known that the marginal effects vary with the values of x (see, e.g., Greene 2000), and it is thus common practice to evaluate the marginal effects at the means of the independent variables. The results of this specification are given in Tables 4-15 and 4-16, labelled as Model 1. Whereas the probability of a transition from direct exports to exporting via an intermediary changes significantly as discussed above, the probability of a transition in the reverse direction is not influenced significantly by any of the independent variables, given that all variables are set to their mean. At first glance, this outcome is somewhat surprising since we found some significant coefficients included in the vector $\hat{\beta}_{01}$. However, it was argued above that a change from exporting via an intermediary to direct exports was primarily observed in the period between the two surveys. Thus, a transition to direct exports generally takes place only in a later stage of a firm's engagement in the particular target market. The predicted probability of a transition from exporting via an intermediary to direct exports in dependence of the years since entry into the target country is depicted in the lower right graph in Figure 4-3, with

Figure 4-3: Predicted Probability of a Change of Sales Mode

Transition direct exports→ intermediary   **Transition intermediary → direct exports**
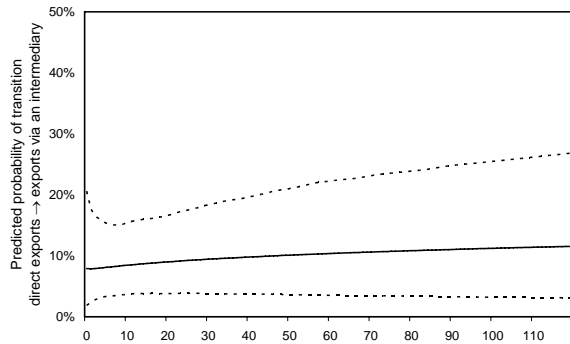
Predicted probability in dependence of
the number of employees
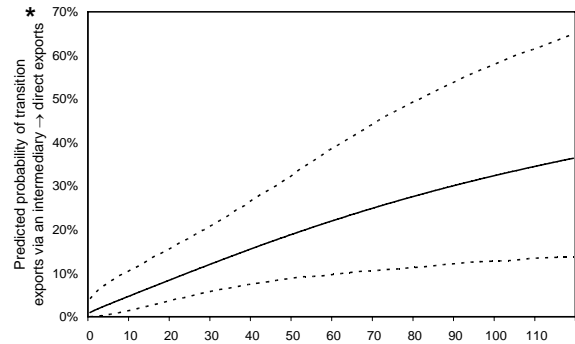
Predicted probability in dependence of
years since entry into target country
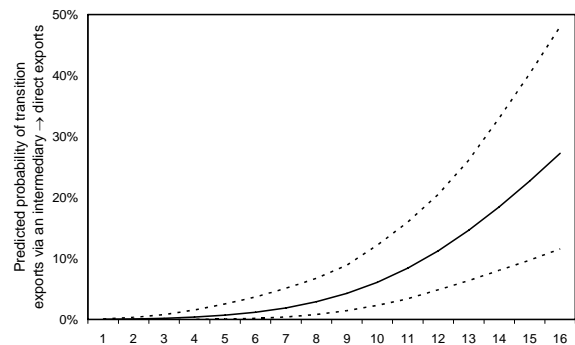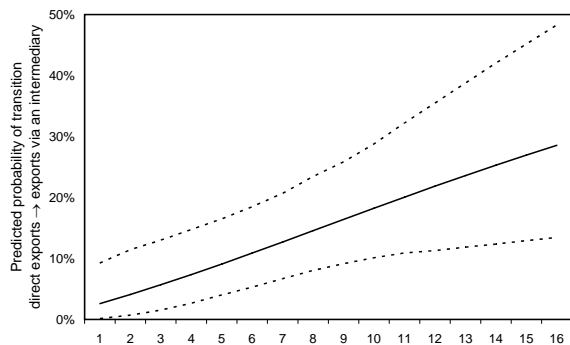
Solid line: predicted probability of transition in dependence of the continuous variable, all other variables set to their mean.
Dotted lines: simulated 90 % confidence interval, using 1,000 simulations.
* Years since target market entry set to the mean of 2003.
Source: own calculation.

all other independent variables set to their mean. The graph reflects the positive correlation be-
tween the time period of the exporter's engagement in the target country and the probability of a
change to direct exports. In the early years a firm generates international sales in the target coun-
try, a change to direct exports is very unlikely. Only after a twelve-year engagement does the
probability of a change exceed the ten-percent level. However, not only the probability of a change
to direct exports rises with the number of years since market entry. The uncertainty of predicting a
transition also increases. Thus, the time period in which the exporter is engaged in the target
market is less appropriate for predicting changes in sales modes during a later stage of the firms'
international activities. In this case, firm-specific or transaction costs-specific variables are proba-
bly more suitable to predict a transition from one sales mode to another. This argument is also true
for a change from direct exports to exports via an intermediary as shown by the lower left graph in
Figure 4-3.

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Table 4-15: Marginal Effects of Logit Model –
Sales Mode Change from Direct Exports to Exporting via an Intermediary

	Model 1	Model 2	Model 3
	Prob. of change = 0.080	Prob. of change = 0.050	Prob. of change = 0.177
	Marginal effect (robust stand. error)	*Marginal effect (robust stand. error)*	*Marginal effect (robust stand. error)*
Country	-0.020 (0.057)	-0.013 (0.036)	-0.039 (0.113)
Engineering	0.537 (0.203)***	0.419 (0.178)**	0.703 (0.210)***
Other manufacturing industries	0.371 (0.150)**	0.268 (0.113)**	0.558 (0.216)**
Log (number of employees)	0.007 (0.020)	0.004 (0.013)	0.013 (0.037)
International experience of management	0.059 (0.045)	0.037 (0.034)	0.120 (0.080)
Permanent R&D activities	0.054 (0.051)	0.034 (0.036)	0.109 (0.098)
Interaction (country risk * perm. R&D)	-0.007 (0.004)*	-0.005 (0.003)	-0.014 (0.006)**
Novel, self-developed technology	-0.016 (0.095)	-0.011 (0.059)	-0.033 (0.195)
Interaction (country risk * novel tech.)	-0.000 (0.005)	-0.000 (0.003)	-0.001 (0.009)
Window of opportunity ≤ 12 months	-0.206 (0.086)**	-0.139 (0.072)*	-0.356 (0.140)**
Intense product customisation	-0.094 (0.055)*	-0.061 (0.044)	-0.178 (0.088)**
Consumer good	0.234 (0.086)***	0.161 (0.075)**	0.389 (0.136)***
Business service	0.141 (0.109)	0.095 (0.075)	0.242 (0.187)
Log (years since entry into target country)	0.091 (0.036)**	0.058 (0.020)***	0.179 (0.111)
Log (GDP of target country)	-0.003 (0.023)	-0.002 (0.014)	-0.006 (0.046)
Rank of country risk 1998	0.004 (0.004)	0.003 (0.003)	0.008 (0.007)
Share of total sales generated in the target country's region	-0.001 (0.002)	-0.001 (0.001)	-0.002 (0.003)

Model 1: All variables set to their overall mean.

Model 2: Like Model 1, but log (employees) and log (years since entry into target country) set to their mean of 1997.

Model 3: Like Model 1, but log (employees) and log (years since entry into target country) set to their mean of 2003.

* 10 % level of significance; ** 5 % level of significance; *** 1 % level of significance.

Base category: entry of a UK-based software/service firm.

Source: own estimation.

**Table 4-16: Marginal Effects of Logit Model –
Sales Mode Change from Exporting via an Intermediary to Direct Exports**

	Model 1	Model 2	Model 3
	Prob. of change = 0.006	Prob. of change = 0.077	Prob. of change = 0.200
	Marginal effect (robust stand. error)	*Marginal effect (robust stand. error)*	*Marginal effect (robust stand. error)*
Country	0.006 (0.006)	0.071 (0.056)	0.153 (0.125)
Engineering	-0.012 (0.012)	-0.131 (0.069)*	-0.292 (0.127)**
Other manufacturing industries	-0.001 (0.006)	-0.017 (0.066)	-0.038 (0.144)
Log (number of employees)	0.007 (0.005)	0.074 (0.034)**	0.167 (0.071)**
International experience of management	0.008 (0.007)	0.097 (0.036)***	0.234 (0.082)***
Permanent R&D activities	-0.006 (0.007)	-0.066 (0.061)	-0.140 (0.129)
Interaction (country risk * perm. R&D)	-0.000 (0.000)	-0.002 (0.003)	-0.004 (0.007)
Novel, self-developed technology	0.016 (0.017)	0.167 (0.081)**	0.167 (0.081)**
Interaction (country risk * novel tech.)	-0.000 (0.000)	-0.004 (0.004)	-0.009 (0.009)
Window of opportunity ≤ 12 months	0.008 (0.008)	0.083 (0.050)*	0.180 (0.095)*
Intense product customisation	0.006 (0.008)	0.067 (0.060)	0.144 (0.119)
Consumer good	-0.008 (0.008)	-0.087 (0.047)*	-0.192 (0.116)*
Business service	0.109 (0.077)	0.568 (0.197)***	0.674 (0.134)***
Log (years since entry into target country)	0.024 (0.017)	0.269 (0.120)**	0.607 (0.210)***
Log (GDP of target country)	-0.002 (0.002)	-0.022 (0.020)	-0.049 (0.041)
Rank of country risk 1998	0.000 (0.000)	0.003 (0.003)	0.006 (0.007)
Share of total sales generated in the target country's region	-0.000 (0.000)	-0.001 (0.002)	-0.001 (0.004)

Model 1: All variables set to their overall mean.

Model 2: Like Model 1, but log (employees) and log (years since entry into target country) set to their mean of 2003.

Model 3: Like Model 2, but dummy variable indicating novel, self-developed technology set to "1".

* 10 % level of significance; ** 5 % level of significance; *** 1 % level of significance.

Base category: entry of a UK-based software/service firm.

Source: own estimation.

Since a transition from exporting via an intermediary to direct exports is only probable during a later stage of an exporter's engagement in the target country, I took the mean number of years between target market entry and the year of the second survey, 2003, for calculating marginal effects. Moreover, the results of the logit regression have shown that switching to direct exports is also positively correlated with firm size. The relationship between the number of employees and the probability of a sales mode change is also depicted in Figure 4-3. Since the firms in our sample grew in the period between the two surveys[114], I further used the mean number of employees at the time of the second survey when calculating marginal effects. This specification is given in Table 4-16 as Model 2. For the third specification in Table 4-16, I further set the dummy variable indicating a novel, self-developed technology to the value 1. As discussed above, the percentage of exporters that used a novel technology at the time of the second survey had increased significantly compared with the first survey. Hence, it is useful to examine the marginal effects given a high degree of innovativeness incorporated into the firm's product.

In Table 4-15, which reflects the marginal effects on the transition probability from direct exports to exporting via an intermediary, I varied the two continuous variables (number of employees and years since target market entry) in a similar manner. Specification 2 shows the marginal effects, setting the two continuous variables to their mean at the time of the first survey, whereas in Model 3, these variables take the value of the mean at the time of the second survey. All other independent variables were set to their overall mean.

The two industry dummy variables have the highest marginal effects on the probability of a change from direct exports to exporting via an intermediary.[115] The second most important marginal effect comes from the dummy variable indicating a consumer good, followed by the dummy reflecting a short window of opportunity and the dummy indicating intense product customisation. As already mentioned, the marginal effect of the interaction term between the rank of country risk and permanent R&D activities is rather small. It only increases the transition probability by about one percentage point. The order of the marginal effects on the probability of switching from exporting via an intermediary to direct exports is similar. Neglecting the influence of the years since target market entry, the highest marginal effect is attributed to the dummy variable indicating that the firm's service is primarily sold to other companies as a business service, followed by the dummy reflecting the firm managers' international experience and the dummy for the engineering sector

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[114] The annualised employment growth rate in the period from 1997 to 2002 of our sample's exporters amounts to 7.7 percent (see section 5.3).

[115] The marginal effect for a dummy variable is the discrete change of the dummy variable from 0 to 1.

(see Model 2 in Table 4-16).[116] The marginal effects of the remaining independent variables that had a significant coefficient increase the probability of a transition to direct exports by between seven and ten percentages points in Specification 2.

The strongest predictors in the transition equations are the dummy variables controlling for unobserved industry-specific factors and those indicating a typical customer of the firms' products or services. Thus, the choice of sales modes is, to a relatively large degree, determined by strategic and structural influences that are not observed by the two surveys this study is based on. Moreover, traditional distribution channels exist for certain kinds of products. For example, a consumer good is traditionally sold via an intermediary, regardless of the context. Hence, the high explanatory power of the dummy indicating a typical customer might reflect embedded routines and experiences the firm has in supplying such a typical customer, e.g., when distributing its product in the domestic market.[117] On the other hand, variables that are intended to measure transaction cost-specific assets (e.g., product customisation) or the firm's (intangible) resources are of minor importance. Nevertheless, the variables derived from the theoretical literature must not be neglected when explaining changes of sales modes – at least not for a transition from exporting via an intermediary to direct exports during a later stage of a firm's international engagement. When a young high-tech firm starts exporting to a foreign target market, it might suffer from the liability of alienness and might therefore make the strategic choice to sell its product via an intermediary, even if this is not optimal from the organisational capability perspective or from a transaction cost point of view. After becoming established in the foreign country, the exporter is no longer forced to use an intermediary. In this case, transaction cost-specific assets or the firm's (intangible) resources gain in importance so that the dummy variable indicating a novel, self-developed technology becomes a good predictor for a transition from an intermediary to direct exports.

In the logit model explaining the determinants of a transition from direct exports to exporting via an intermediary, McFadden's R^2 reaches a value of 0.355; in the logit model examining a reverse transition, McFadden's R^2 is 0.419. Hence, the empirical model fits well with the data. It should be noted, however, that in the logit model for a transition from exporting directly to exports via an

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[116]   In Table 4-16, the marginal effects for Model 3 are generally higher than for Model 2. Of course, the marginal effect of the dummy variable indicating novel and self-developed technology is the same in the two specifications since the only difference between the two models is that the latter dummy variable is set to 1 in Model 3.

[117]   The first survey also contains information about the dominant sales mode used in the domestic market, i.e., whether the firm's product is primarily sold via distributors or by direct sales from headquarters. Bürgel and Murray (2000) included this information when estimating a probit model of the choice on mode of entry into a foreign market made by the UK-based firms in our sample. They found out that the domestic sales mode is the strongest predictor of the chosen foreign entry mode. This finding stresses the importance of firm-specific routines.

intermediary the independent variables are jointly significant only at the 5 % level according to a Wald test against the constant-only model. Although this result should not cause any concern from a statistical point of view, it shows that the influence of random effects on the probability of a transition from direct exports to exports via an intermediary is still relatively important. This might be due to the fact that for some firms, entering the foreign market by direct exports was a result of an unsolicited, i.e. random, order from abroad. For these firms the sales modes used in period t-1 are not a consequence of the firms' strategic decisions but of random events. Under these circumstances, it is difficult to predict a transition from direct exports to another sales mode based on the (changing) independent variables included in the regression equation.

4.4.5 Conclusion

As the third dimension of our sample's firms' international engagement, the objective of this section is to investigate the change of sales modes in foreign markets on the part of German and UK exporters. The two most frequently used sales modes were direct exports and exporting via an intermediary. Even in 2003, when our sample's exporters had been engaged in their most important target markets for an average of 9 years, more resource-intensive sales modes like sales subsidiaries or even FDI were still of minor importance. Therefore, I decided to examine changes between the two distinct modes of exporting. Descriptive analyses reveal that just under 16 % of exporters that sold their products directly to their foreign customers in the previous period switched to exporting via an intermediary. A sales mode change in this direction was observed (not exclusively but) primarily in the period between target market entry and the first survey, i.e., during an early stage of the firms' export activities. On the other hand, a change in the reverse direction took place primarily in a later stage of the firms' international engagement. Just under 10 % of those firms that exported via an intermediary in the previous period changed to direct exports. Thus, we observe a high persistence in the sales modes used over time, probably because of the existence of sunk costs or because of binding contracts an exporter made with its foreign distributors or customers.

The only theory that derived a time-dependent order of sales modes, the internationalisation process model, is not suitable for explaining the behaviour of young firms in high-tech sectors. The descriptive result that firms change from direct exports to exporting via an intermediary during an early stage of their international engagement and that a transition in the other direction is observed during a later stage already contradicts the notion of the process model that an exporter gradually increases its commitment in a foreign market, regardless of which sales mode is considered as the more resource-intensive commitment. Further, the percentage of firms that use resource-intensive

sales modes like sales subsidiaries is still relatively small, leaving almost no evidence that firms incrementally raise their commitment of resources.

Instead, the econometric analysis confirms that the transaction-cost theory and the resource-based view of the firm (and the organisational capability perspective which is based on the latter theory) are both relevant for explaining the probability of switching from one sales mode to another. Alternatively, Dunning's eclectic paradigm turned out to be a useful framework for investigating sales mode changes – apart from the fact that we do not find evidence for the relevance of locational advantages. Nevertheless, ownership advantages (e.g., the firm's physical, financial, and intangible assets) and internalisation advantages (e.g., transaction-specific assets like the requirement of intense product customisation) are decisive for selecting the optimal sales mode, especially for predicting a sales mode change from exporting via an intermediary to direct exports. This is an important result since most existing empirical studies examine either the choice of entry mode (i.e., the first sales mode used in a foreign market) or the selection of the sales mode used by a firm at a particular point in time. This study proves that those theories, which are already known to be able to account for the choice of entry modes, are also appropriate for explaining changes of sales modes, or in other words, a sequence of sales modes observed over a longer time period. The main managerial implication of this section's analyses is that from a transaction-cost reasoning and an organisational capability perspective, an exporter of a high-tech product which incorporates highly sophisticated technologies should use an integrated sales mode, that is, in the case of a young and small high-tech firm, direct exporting.

However, especially during an early stage of a high-tech firm's international engagement there are strategic and structural influences that might dominate the impact of the exporter's (intangible) resources or its transaction-specific assets. Due to the liability of alienness, an exporter might be forced to use an intermediary to sell its products abroad since foreign customers might not trust a young and small firm that is even not established in its domestic market. In this case, the reputation of an established foreign distributor or agent might be a way of gaining indirect legitimacy. After becoming established in the foreign market, the domestic high-tech firm might be able to refrain from using a foreign distributor and decide on its sales mode based on its intangible and transaction-specific assets.[118] Moreover, the transaction-cost reasoning and the OC perspective

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[118] Bürgel and Murray (2000) further argued that accepting the product of a young innovative firm might not be attractive from the foreign distributor's point of view either. The distributor also has to invest, for instance, in specialised training of his sales personnel, although the return of this investment is highly uncertain. Thus, the distributor has to be paid to bear this risk, which makes exporting via an intermediary quite expensive for a small high-tech firm. If it is nonetheless forced to use an intermediary in the foreign market due to the liability of alienness, it will be interested in switching to direct exports as early as possible.

might be dominated by the existence of traditional distribution channels. Consumer goods, for example, are traditionally distributed via intermediaries. Of course, these traditional sales modes might change over time. The growing importance of e-commerce for distributing software and other digital products might induce software firms to change to direct exports via the Internet. Our results are consistent with this interpretation. Finally, this section's empirical results show that there are unobserved industry-specific effects which are actually the best predictors in our model. Therefore, in order to explain the selection of sales modes by young high-tech firms, the theories usually applied are useful but not sufficient. Firms might deviate from the sales mode choice predicted by existing theories. Future research should pay more attention to these strategic constraints a young high-tech firm has to consider in order to better understand a chosen sequence of sales modes.

5 Productivity, Growth, and Exports

Today, the overwhelming majority of economists and politicians are convinced that an outward-looking export-oriented policy positively affects a country's welfare – for example by increasing GDP growth rate or improving productivity. Aggregate cross-country data sets have been used in the past to explore the relationship between trade and macroeconomic indicators.[119] More recently, however, a growing literature investigates at the microeconomic (read: firm) level how international trade is related to various measures of firm performance. If there are positive effects of trade on macroeconomic indicators, they should be reflected by microeconomic data such as improved firm performance.

International engagement may be especially important for small technology-oriented firms, since export activities are often regarded as one way to amortise these firms' high product research and development costs. Examining the cross-sectional data set of the first survey this study is based on, Bürgel et al. (2004) found out that internationalisation did indeed improve the firms' labour productivity and increased their annualised sales growth rates between the firms' start-up and 1997, but did not affect employment growth. These results, however, contradict many other studies examining the causal relationship between exports and firm performance. All of these studies confirmed the stylised facts that exporters are larger, more productive, and exhibit higher growth rates; but most, including those by Clerides et al. (1998), Bernard and Wagner (1997), and Bernard and Jensen (1999), found a reverse causality, i.e., the superior performance of internationally active firms is a result of self-selection of "good" firms into the international market. Conversely, there is little evidence that internationalisation has a causal effect on firm performance.

One can quite reasonably assume that young high-tech firms behave differently from the firms studied in the papers cited above. Firstly, most other studies examined mature firms, in contrast to our sample of newly founded firms that were observed in 1997. Secondly, there may be structural differences in firms operating in high-technology sectors compared with firms in low-tech sectors. For example, technology-oriented firms might improve their labour productivity because they can better profit from learning effects by exporting (see the "learning by exporting" hypothesis in the next section) than low-tech firms.

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[119] See Baldwin (2000) for a discussion of theoretical and empirical studies analysing the relationship between trade and macroeconomic growth. Baldwin emphasised that there is still considerable controversy among economists as to how trade and economic growth interact. Particularly, there is disagreement on the precise effects of various trade policies (e.g., trade taxes, subsidies, quotas) on growth.

In order to find out whether the observed causal effects remain valid as high-tech firms age because the causalities are a result of structural differences particular to them, or whether the positive effects are restricted to the start-up period, this chapter re-examines the relationship between export behaviour and firm performance using data from the second survey conducted in 2003. In accordance with Bürgel et al. (2004), two different indicators of firm performance will be investigated: labour productivity (measured as sales per employee) and firm growth in the period from 1997 to 2002 (employment as well as sales growth). The relationship between these two indicators of firm performance and the firms' export behaviour will be elaborated using two different econometric methods. In a first step, I will estimate simultaneous equation models (section 5.4). This allows a simultaneous estimation of probability of exporting and of the determinants of firm performance. The individual equations the econometric model is based on (labour productivity, growth, and internationalisation equations) will be derived in section 5.2. In the second step, I will apply matching techniques which estimate the causal effect of exporting by comparing the mean outcome (productivity or growth) of internationally active firms with that of a control group of domestic firms (section 5.5). By using two different econometric approaches, I will check the robustness of my results. At first, however, I will review theoretical arguments and empirical studies that deal with the relationship between performance and internationalisation.

5.1   Performance and Internationalisation

Depending on which performance indicator is regarded, different theoretical arguments have been derived on how firm performance and international business activities might be related. The direction of causality, however, is not clear a priori. On the one hand, exporting might improve firm performance. On the other, firms with superior performance might become exporters. In the following, I will summarise arguments that relate internationalisation and the two performance indicators analysed in this chapter, productivity and growth. In related literature, the relationship between survival and internationalisation is also discussed (see, e.g., Sapienza et al. [2003] for theoretical arguments and Yli-Renko et al. [2004] or Bernard and Jensen [1999] for empirical results). Since this study's econometric analysis is based on survey data and only the representatives of still-living firms have been contacted, the influence of being an exporter on the probability of survival cannot be examined empirically. I will neglect the latter relationship hereafter. It should be emphasised that productivity, growth, and survival are neither exclusive nor independent from one another. At least in the long run, these three performance indicators can be expected to be positively correlated. For example, growing firms might profit from economies of scale so that a given number of employees can produce more output, which, taking the product

price as given, results in higher sales per employee – our measure of labour productivity. Similarly, economic theory predicts that in any industry, the least productive firms exit from the market first, thus showing a smaller survival probability.[120]

One of the most frequently heard arguments on how productivity and internationalisation might be related is the "learning by exporting" hypothesis. Exporting firms are supposed to learn from internationally leading customers, suppliers, or competitors with respect to best practice technology or even product designs (see, e.g., Evenson and Westphal 1995). Thus, exporters may profit from technological or knowledge spillovers. In other words, the productivity-increasing effect of international sales results from knowledge and expertise on the foreign market that non-exporters do not have (Aw et al. 2000).

Another argument is mainly associated with McKinsey (1993b). Firms that have international sales are assumed to be exposed to greater competition than firms with domestic sales only. They are forced to exploit their resources more efficiently, reduce costs and increase their productivity in order to remain exporters. However, one might object that in open economies like Germany or the UK, domestic firms also face competition from foreign companies because of imports to the domestic market ("imported" competition; see Bernard and Wagner 1997).[121]

Labour productivity, however, is not necessarily the main interest of policy makers, employees, investors, or owners. The two former groups are primarily concerned with the employment-generating effect of internationalisation, whereas investors and owners focus on sales or a firm's market value. Since the foreign market could be regarded as an expansion of the domestic market, firms can realise economies of scale and an ensuing increase in sales and employment by carrying out international business activities. This mechanism is known in related literature as export-led growth (see Feder 1982). Moreover, international sales can compensate for variations in domestic demand (Bernard and Wagner 1997), lowering the dependence of a firm's growth processes on the domestic market.

The argument of export-led growth seems to be especially important for young technology-oriented firms. These firms often produce highly specialised products or services (niche strategy) in limited domestic markets, making international business activities the only way to ensure long-term company growth. Moreover, young high-tech firms are often faced with high costs of re-

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[120]   In some cases, however, the correlation between different performance indicators might be negative. Reid (1995), for example, found a trade-off between profitability and growth for young, small firms in Scotland.

[121]   In fact, the latter argument is often stated by the literature concerning development economics. In developing countries, firms are often confronted with barriers to entry into the domestic market, implying less fierce competition (see Aw and Hwang [1995] for further details).

search and development. If exports lead to higher growth rates, this can facilitate the amortisation of high product R&D costs (Bürgel et al. 2004).

International engagement is associated with significant entry costs, such as marketing campaign expenses or the costs of setting up foreign sales channels, which may be regarded as sunk costs. Small and less productive firms might not be able to bear these costs. Therefore, we should observe that only firms that have achieved a certain size or a certain level of labour productivity enter the foreign market. This leads us to anticipate a self-selection of firms with superior performance into the international market. This argument describes the reverse causation: Firms with "good" performance become exporters (cf., e.g., Bernard and Wagner 1997 or Bernard and Jensen 1999).

Based on the Ricardian theory of comparative advantage, Bernard et al. (2000) derived a theoretical trade model that traces back the self-selection of firms with higher productivity into the export market to firm-specific differences in efficiency.[122] International business activities constitute a higher "efficiency hurdle" (Bernard et al. 2000, p. 15) than domestic sales.[123] Thus, firms with higher efficiency are more likely both to export and to have higher measured productivity, which corresponds to the usually observed stylised fact that exporting firms are more productive on average. The model is also able to explain the stylised fact that firms with international business activities tend to be larger. More efficient firms are not only more likely to export, they are also more likely to charge lower prices, which, in the case of an elastic demand, will lead to higher sales (see Bernard et al. 2000, p. 16, for more details). Similarly to Bernard et al., Melitz (2003) developed a monopolistically competitive model of trade with firm heterogeneity. According to his model, only more productive firms export while simultaneously firms with low productivity may not survive, or survive but only serve their domestic market.

The amount of empirical literature examining the relationship between firm performance and internationalisation has grown considerably in recent years (see Wagner [2005] for an extensive review of 45 microeconometric studies with data from 33 countries). Clerides et al. (1998) tested empirically a theoretical model of export participation and learning effects using a data set of

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[122] Firm efficiency is defined as the inverse number of input bundles necessary to produce one unit of output. Thus, a firm is more efficient when it needs fewer input bundles to produce one unit of output. In contrast, productivity is defined as the value of output (i.e., sales) per bundle of input, or per an input factor like number of employees. Under perfect competition, measured productivity is equal to the price of the input bundle regardless of a firm's relative efficiency. Under imperfect competition, productivity is the price of the input bundle times a firm-specific markup. Bernard et al. (2000) proved that, in their model, more efficient firms charge, on average, a higher markup. Therefore, differences in productivity reflect differences both in efficiency and in a firm's monopoly power.

[123] In the model, among all potential producers of any good only the most efficient ones serve the (domestic) market.

manufacturing plants in Colombia, Mexico, and Morocco observed in the 1980s. Descriptive analyses confirmed that exporting plants were more productive than their non-exporting rivals. The question of causality, however, remains. Based on their model, Clerides et al. derived two conflicting hypotheses. If learning effects are prevalent, the trajectories of average costs must reveal a cost reduction after the plant has entered the foreign market. If, however, plants with superior productivity become exporters, cost reductions must be present before the plants start exporting. Applying simulation techniques and simultaneously estimating an autoregressive cost function and a dynamic export market participation equation, Clerides et al. found evidence for the latter scenario, i.e., the positive relationship between status of internationalisation and labour productivity is a result of the self-selection of more productive plants into foreign markets.

Bernard and Jensen (1999) and Bernard and Wagner (1997) produced similar results when analysing panel data of US and German manufacturing firms respectively. Most importantly, both studies confirmed that firms with superior performance self-select into the international market. Bernard and Jensen found that exporting firms benefit from their international engagement, enjoying higher employment growth rates after foreign market entry and a higher probability of survival compared with non-exporting firms. However, the study of Bernard and Wagner revealed that the higher survival rates of exporting German firms can be explained by their superior performance characteristics before foreign market entry.

Using the same data set as Bernard and Wagner (1997), Wagner (2002) introduced the application of matching techniques in order to re-examine the export-performance relationship. In contrast to the earlier results, he then obtained evidence of the significantly positive effects that starting to export has on employment growth and wages, but no statistically significant causal effect on labour productivity. Also using a matching approach, De Loecker (2004) proved that exports generate higher total factor productivity in the case of Slovenian manufacturing firms. Analysing a panel data set of UK firms, Girma et al. (2002) applied matching techniques and found a feedback relationship between the firms' export activities and productivity (labour productivity as well as total factor productivity): Highly productive firms become exporters, but exporting also increases productivity. Apparently, using matching techniques leads to results that are more in favour of a causal effect of international business activities on firm performance. However, the results are still mixed. Arnold and Hussinger (2005) examined German manufacturing firms from the Mannheim Innovation Panel. The results of their matching analysis are in line with most of the studies cited above: Causality runs from productivity to exporting and not vice versa. Therefore, it remains questionable to what extent the conflicting findings are a consequence of varying empirical methodologies or structural differences of the analysed firms.

Using data from the first survey this study is based on, Bürgel et al. (2004) investigated the relationship between firm performance and internationalisation behaviour for the period from the firms' start-up until 1997. They found that an international engagement improves labour productivity and increases the sales growth rate, but does not affect the employment growth rate. The foreign market may be particularly important for young, small, technology-oriented firms, especially for those operating in a narrow market niche. Similarly, productivity-increasing learning effects might be more relevant for newly founded firms than for mature firms investigated in the papers quoted above (compare the theoretical models of "active" and "passive" learning developed by Ericson and Pakes [1995] and Jovanovic [1982], respectively). Moreover, young high-tech firms can be expected to be able to absorb the information gained on the international market and transform this information into increased productivity. Hence, there are arguments as to why the firms in our sample might have structural peculiarities that lead to causal effects of exporting on firm performance contradictory to most of the other studies cited above, especially with respect to labour productivity. The subsequent analysis addresses the question of whether the causal relationships pointed out by Bürgel et al. remain valid as firms age and reach a more "mature" stage of their life cycles or whether the positive role of exports is restricted to the firms' start-up periods.

5.2   The Model

Labour Productivity Equation

It is assumed that firm i produces according to a Cobb-Douglas production technology. Output Y_i is a function of the production factors physical capital (K_i), R&D employees (R_i), and non-R&D employees (L_i):[124]

(5.1) $Y_i = A \cdot K_i^{\alpha} \cdot R_i^{\beta} \cdot L_i^{\gamma} \cdot e^{u_i}$.

The scalar A is a parameter of production efficiency that shifts the isoquants of the Cobb-Douglas production function in parallel to the origin. The exponents α, β, and γ denote the partial production elasticities of output with respect to capital, R&D, and labour, respectively, and u is a normally distributed error term. Taking logarithms and subtracting labour from both sides results in an equation for labour productivity, i.e., output per non-R&D employee:

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[124]   Research and development often enters the production function as R&D capital (cf. Hall and Mairesse 1995). However, due to data restrictions R&D capital is sometimes approximated by R&D employees. In order to avoid double-counting, labour input is then measured by number of non-R&D employees. I decided to include R&D employees directly as an input factor, not least because, for the service firms in our sample, the knowledge-based production process can better be described by labour input than by R&D capital.

$$(5.2) \qquad \ln\left(\frac{Y_i}{L_i}\right) = \ln A + \alpha \cdot \ln\left(\frac{K_i}{L_i}\right) + \beta \cdot \ln\left(\frac{R_i}{L_i}\right) + (\mu - 1) \cdot \ln L_i + u_i.$$

The sum of production elasticities $\mu = \alpha + \beta + \gamma$ will be unity if the production function has constant returns to scale. Thus, the coefficient of the logarithm of labour $(\mu - 1)$ measures departure from constant returns so that equation (5.2) already includes a test for constant returns. This implies that the input factors capital and R&D employees enter the labour productivity equation as intensities with respect to non-R&D employees.[125]

To implement the labour productivity equation econometrically, output is measured as sales per 1,000 euro in 2002. Thus, labour productivity is measured as sales per non-R&D employee. In order to determine R&D employment, firms were asked how many of their employees spent at least 50 % of their time on research and development of new and existing products or services. Taking this number, I apply the most conservative estimate of R&D employment by assuming that all R&D employees only devote 50 % of their time to R&D. The number of R&D employees given by the firms is therefore halved to produce an estimate of R&D employment that will be used in the econometric model.[126]

The most severe specification problem lies in finding an approximation of firm-specific stocks of physical capital. It is generally not possible to collect information on capital stock by survey, especially not when carrying out telephone interviews. A panel data set containing information on investment in physical capital over a longer time period – a decade for instance – would allow calculation of capital stock using the perpetual inventory method.[127] Unfortunately, we only have information on investment in physical capital for the year preceding the second survey, i.e., 2002.[128] Therefore, I decided to use this value of gross investment in physical capital in 2002 to approximate physical capital.[129]

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[125] This transformation of the Cobb-Douglas production function was also used by Hall and Mairesse (1995).

[126] My results are not sensitive to this assumption. Using alternative approximations of the number of R&D employees, the estimated coefficients are almost identical to the results shown in section 5.4.

[127] This method is described, among others., by Griliches (1979).

[128] Information on investment was not collected by the first survey in 1997.

[129] This approximation of capital stock was already applied by Bertschek and Kaiser (2004) and Bertschek et al. (2004). As an alternative, Bürgel et al. (2004) used data from the Mannheim Innovation Panel (MIP) to calculate an industry-specific approximation of capital stock when analysing the labour productivity of the firms that answered the first survey in 1997. The main advantage of the latter approach is that the absolute value that enters the labour productivity equation is likely to be a good approximation of unobserved capital stock. On the other hand, firm-specific variation is neglected when using industry-specific estimates. The main problem with the approach used in this chapter is that gross investment in physical capital often varies significantly from one year to the next. Hence, the results might have been different had we merely used the value of gross investment in 2001

Finally, two industry dummy variables and a dummy variable indicating whether a firm is located in Eastern Germany are added to the productivity equation. The first industry dummy variable characterises firms that belong to an engineering industry, the second indicates firms from other manufacturing sectors including ICT-hardware and health/life sciences. Thus, service firms are used as the base category. The dummy variable for Eastern German firms is intended to cover the well-known fact that firms in the eastern part of Germany exhibit a lower productivity compared with their competitors from the established Western European market economies.[130]

Growth Equations

From a policy point of view, technology-oriented firms are expected to create new jobs. Politicians and employees are thus primarily interested in (long-term) employment growth. Similarly, sales growth could be regarded as the main goal of owners and investors. Therefore, firm growth is examined as the second performance indicator for the surveyed firms. Although the relationships between internationalisation and employment and sales growth are estimated separately, the two growth equations are broadly identical, allowing the following combined discussion of both the employment growth equation and the sales growth equation.

Firm growth is observed over the period between the two surveys, i.e., between 1997 and 2002. The logarithm of the annualised growth rate G is given by (see, for example, Evans 1987a, 1987b)

$$(5.3) \qquad \ln G_i = \frac{\ln E_{i,t_2} - \ln E_{i,t_1}}{t_2 - t_1},$$

where E is either number of employees or the respective firm's (discounted) sales, t_1 is 1997 and t_2 is 2002. The growth equation is specified as a simple heuristic equation

$$(5.4) \qquad \ln G_i = X_i \delta + u_i,$$

where u_i is a normally distributed error term. In keeping with related literature on firm growth, a vector of exogenous variables X_i is identified that is intended to affect the firms' growth rates.

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instead of that of 2002. However, the econometric results of this chapter, as well as the results of Bertschek and Kaiser (2004) and Bertschek et al. (2004), give plausible estimations of the partial production elasticity of capital, i.e., the parameter we are interested in.

[130] DIW et al. (2003) stated that in Eastern Germany in 2002, GDP per employee only amounted to 71 % of the corresponding Western German value. Descriptive analyses of the firms in our sample also show that the labour productivity of Western German firms is significantly higher than that of UK-based firms. However, the dummy variable for Western German firms is not significant in the productivity equation. An obvious explanation for this is that Western German firms are either better equipped with firm-specific resources than UK-based firms or that they exploit their resources more efficiently than their UK counterparts. Therefore, a dummy variable for West Germany will not be added in the final econometric specification.

Based on Gibrat's Law (Gibrat 1931), there are numerous theoretical and empirical studies that examine the relationship between firm size and growth. Whereas Gibrat's Law postulates that growth is independent of firm size (Simon and Bonini 1958, Lucas 1978), empirical studies have proved that at least for young and small firms like those in our sample, (employment) growth decreases with firm size (see Sutton 1997 for a survey). The main theoretical argument as to why growth and size are negatively correlated is as follows[131]: Firms are often founded with a sub-optimal size, i.e., smaller than the minimum efficient scale (MES). By collecting information on its own productivity and competitors, a young firm approaches the MES in the early years after firm formation (see Ericson and Pakes 1995 or Jovanovic 1982). This theoretical concept assumes a neo-classical *U*-shaped average cost curve and implies that a firm will not grow larger than its MES in order to avoid increasing average costs. This concept is, however, inconsistent with long-term growth, this study's actual intended focus. To explain long-term growth beyond the MES, we must assume imperfect competition, making the cost curve *L*-shaped. In this case, firm growth will only be restricted by the demand for the respective firm's product (see Hart 2000).

In the empirical model firm size will be measured by the logarithm of number of employees (sales) at the beginning of the growth period, i.e., 1997. Empirical studies (for example, by Evans 1987a or Almus et al. 1999) have shown a non-linear relationship between size and growth, whereby the negative effect of size on firm growth decreases as firms approach their MES. Therefore, I will also include the square of the logarithm of employees (sales) in the growth equation.

Similarly to the arguments that relate size and growth, a negative correlation between firm age and growth is hypothesised. Young firms can realise high efficiency gains due to learning processes, which lead to higher growth rates (Ericson and Pakes 1995, Jovanovic 1982). These efficiency gains decrease as firms become older. To test this hypothesis, I will include the logarithm of firm age in 1997 (measured in years).

Investment in R&D is of major concern to technology-oriented firms. The growth-enhancing effect of R&D activities was already proven for the start-up periods of the firms in our sample by Bürgel et al. (2004). R&D activities can be regarded as constituting an intangible asset that fosters firms' growth processes as argued by the resource-based view of the firm (e.g., Penrose [1959], Werner-felt [1984], or, in the context of firm growth Geroski [2000]). However, R&D activities are not necessarily exogenous if a firm decides on the amount of R&D based on its growth prospects (see,

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[131] An evolutionary theory that explains the negative correlation between size and growth was formulated by Cabral (1995). Nelson and Winter (1982), on the other hand, described a positive relationship between size and growth: Firms develop successful routines, allowing firms that have grown faster in the past to continue growing ("persistence of chance", Wagner 1992).

e.g., Felder et al. 1996). Furthermore, using R&D intensity as the exogenous variable is problematic, since we only know the firms' R&D intensity in 1997 and 2002. However, the firms' growth rates between 1997 and 2002 are certain to have been affected by their interim R&D activities as well. Therefore, instead of R&D intensity I consider two dummy variables that indicate whether a firm is carrying out R&D on a permanent basis or occasionally. Firms with no R&D activities are used as the base category. These two dummy variables better describe the firms' long-term R&D activities. Moreover, the problem of endogeneity is likely to be less severe for the two dummies than for R&D intensity. Since the dummy variable for occasional R&D activities turned out to be insignificant in the sales growth equation, it was excluded from the sales growth regression.[132]

From a theoretical as well as an empirical point of view, human capital of firm managers is regarded as one of the most important factors influencing firm growth. It can be expected that higher levels of firm managers' human capital imply increased knowledge and capabilities with respect to organisation or financial and general management (see, e.g., Bates 1990, Brüderl et al. 1998). Since it is difficult to measure the abstract concept of human capital directly, the econometric model will include two dummy variables that take the value 1 if the respective firm's managers experienced a "serious" or a "very serious" shortage of skills in marketing or R&D. These two dummy variables are hypothesised to reduce firm growth.

The role of imperfect competition was already stressed while discussing the relationship between firm size and growth. The argument was made that imperfect competition enables firms to realise long-term growth. In interviewing the firms in our sample, we asked firm representatives to estimate the time a competitor would need to launch either a similar product with superior performance or a product with similar performance at a lower price. This competition-free time period in which firms can realise temporary monopolistic rents is called the "window of opportunity". In section 4.4, this variable already proved to have an impact on a firm's decision on the appropriate sales mode. It might be intuitive that a longer competition-free period leads to a higher growth rate. However, as Porter (1979) and Caves and Porter (1979) argued, firms that successfully occupy a narrow strategic segment do not need to exploit their competitive advantage and grow rapidly in order to survive in their chosen market segment. Slow growth is then compatible with a niche product strategy. According to the econometric modelling in section 4.4, I will include a dummy variable in the econometric growth equation that takes the value 1 if the estimated window of opportunity is one year or shorter.

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[132] In analysing the growth models, I also estimated a specification that includes R&D intensity. However, R&D intensity was insignificant in both the employment growth and sales growth equations.

Firms that face a short window of opportunity are forced to improve their products or to market new products or services. Thus, the age of the product may also be important for firms' growth (see Bürgel et al. 2004). Firms with relatively old products are hypothesised to grow more slowly since their products are likely to be out-of-date. Especially in high-tech industries with short product life cycles, products rapidly change or become obsolete.[133] In the questionnaire, the firms' representatives were asked in which year the then currently best-selling product was first sold by the company. Using this information, I will include the logarithm of the product's age in 2003 in the sales growth regression. I also tested this variable in the employment growth regression, but it turned out to be insignificant and will therefore be neglected in the final specification.

The growth equation will be completed by two industry dummy variables (for the engineering industry and other manufacturing industries including ICT-hardware and health/life sciences) and by a regional dummy variable taking the value 1 if the firm is located in Germany. In contrast to the productivity equation, I will not use a dummy variable for Eastern Germany because descriptive analyses reveal that there are only minor differences in firm growth between Western and Eastern Germany, but significant differences between Germany and the UK.

Internationalisation Equation

A profit-maximising firm will decide to internationalise if the benefits of exporting exceed the costs associated with international business activities. Potential benefits can be a result of an increased growth rate or improved labour productivity. Since the costs of international business activities cannot be observed directly, I will formulate different hypotheses concerning the factors likely to influence a firm's decision regarding exporting. In order to identify the internationalisation equation, exogenous variables are needed that increase or reduce firms' (potential) costs of international business activities, but that are independent of growth and labour productivity (see also the explanation of the econometric model in section 5.4). For example, R&D activities play an important role in the decision to internationalise. They generate assets by which a firm distinguishes itself from its competitors. These assets not only facilitate foreign market entry – they also support a long-term engagement in the international market (see chapter 4). However, as shown in the previous subsections, R&D may also be decisive for long-term growth and above-average labour productivity. In fact, the number of R&D employees is directly included in the labour productivity equation (5.1) as a production factor and (permanent) R&D activities are postulated to

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[133] Of course, firms may innovate and improve their products gradually so that even if the product is fairly "old", it might incorporate the latest technology.

increase the respective firm's growth rate in equation (5.4). Therefore, R&D activities are not suitable to identify the internationalisation equation.

Based on the results of chapter 4, the following explanatory variables are supposed to be independent of overall firm performance but can be expected to identify the internationalisation decision. According to the internationalisation process model developed by Johanson and Vahlne (1977, 1990), international business activities are associated with uncertainty. A firm increases its international activities gradually, starting with no international activities and entering its first foreign market at a later stage of its life cycle. However, as an exception to the process model, Johanson and Vahlne (1990) mentioned the possibility that knowledge necessary to reduce uncertainty about a foreign market can be acquired by employing an internationally experienced manager, enabling firms to take larger and faster internationalisation steps. The international experience of firm managers can also be regarded as an intangible asset that facilitates firms' export activities from a resource-based view of the firm (see, e.g., Wernerfelt 1984 and the explanations in the previous subsection). Thus, the two well-known dummy variables indicating whether a member of the firms' management team had work experience abroad or whether a manager was educated abroad before joining the company will be included in the internationalisation equation.

Product characteristics may influence firm's internationalisation behaviour. High customisation requirements may act as a constraint to entering the foreign market since they involve close contact with end-users, inducing high transaction costs prior to selling the product (cf. Williamson 1985). For the econometric estimations, a dummy variable will be used that takes the value 1 if the firm has classified the requirement of customisation as "important" or "very important". This variable has already proved to represent a decisive transaction-specific asset that significantly affects the firms' international business activities (see chapter 4).

5.3   Descriptive Analysis

On average, in 2002 the firms in our sample had sales of 3.6 million euro, employed 26 individuals and invested 213,000 euro. Table 5-1 compares the means of exporters and non-exporters. The results are in line with many other studies analysing the relationship between internationalisation and firm performance[134]: Firms with international business activities have, on average, higher sales, more investments, and a greater number of employees. The latter is true for non-R&D employees as well as for number of employees working in R&D. Whereas firms with international sales have an average of about three employees working on research and development of new and

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[134]   See section 5.1 and the literature quoted therein.

existing products, firms that do not export employ only one full-time worker for R&D activities on average.[135] Moreover, within the group of non-exporters more than half of the firms do not conduct any R&D activities. Consequently, the median of number of R&D employees in this group is zero. In contrast, only 12 % of the firms with international sales do not carry out R&D activities. This result corresponds to the values of R&D intensity in the lower part of Table 5-1: Firms with international sales spend just under 16 % of their total sales on R&D, while firms without exports allocate only just over 4 % on average for this purpose.

Interestingly, this significant difference between exporters and non-exporters with respect to R&D activities can only be observed based on the data of the second survey (see also the descriptive analysis in section 4.2.2). Comparing R&D activities in 1997, i.e., at the time of the first survey, no significant difference in mean R&D intensity could be found. Both exporters and non-exporters spent about 15 % of their total sales on R&D.[136] Obviously, during the period between the two surveys, R&D activities became a distinctive characteristic by which an internationally oriented firm distinguishes itself from its domestically focused competitors.

Table 5-1:   Comparison of Firms with and without International Sales in 2002

	with international sales				without international sales				
	mean value	median	standard deviation	N	mean value	median	standard deviation	N	t-test [f]
Sales [a]	4,196.6	2,623	5,582.26	148	2,197.1	1,097	2,449.30	54	***
R&D employees	2.9	2	4.27	138	0.9	0	1.75	45	***
Non-R&D employees	28.5	18	38.87	137	14.5	8	16.07	45	***
Investments [a]	249.9	80	440.22	135	111.3	32	237.16	47	***
Labour productivity [b]	179.6	150.0	109.63	129	165.1	126.2	114.04	44	
Annualised employment growth rate [c]	7.7	5.9	12.66	157	2.2	3.1	11.29	55	***
Annualised sales growth rate [c d]	14.6	13.0	14.93	141	8.3	7.4	12.20	51	***
R&D intensity (in %) [e]	15.8	10	23.72	148	4.4	0	7.73	53	***
Age (in years)	11.7	11	2.57	159	11.3	11	2.86	55	

[a] in € 1,000s;   [b] Sales per non-R&D employee in € 1,000s;   [c] Period 1997 – 2002;   [d] Growth rates were computed using discounted sales;   [e] Expenditures on R&D as percentage of sales;   [f] t-test on the equality of means.
* 10 % level of significance; ** 5 % level of significance; *** 1 % level of significance.
Source: ZEW, University of Exeter, own calculations.

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[135]   Recall that the number of R&D employees given in Table 5-1 is an estimate based on the assumption that all R&D employees indicated by the firms' representatives only work on R&D for 50 % of their time.

[136]   Nevertheless, econometric analyses showed that R&D intensity had a positive impact on probability of internationalising in 1997 (Bürgel et al. 2004).

Descriptive statistics of the three chosen performance indicators that will be analysed econometrically (labour productivity, employment growth, sales growth) are also included in Table 5-1. Similarly to the other variables discussed above, mean labour productivity is higher for firms with international sales than for firms without exports. However, based on a t-test the difference is not significant. Regardless of whether or not a firm has international sales, it must ensure a certain level of productivity if it wants to survive. A firm without international business activities cannot afford to fall behind its internationally active competitors who (typically) also supply the domestic market. Therefore, there are only relatively small differences between exporters and non-exporters with respect to labour productivity. Figure 5-1 shows kernel density estimations of the log-labour productivity for German and UK-based firms. Both density functions are quite similar, indicating a similar distribution of log-labour productivity among German and UK firms. The density function for German firms lies slightly to the right of the UK function, showing that German firms have, on average, a slightly higher log-labour productivity than UK firms. It should be noted, however, that the labour productivity of Western German firms is significantly higher compared with UK-based firms, but the labour productivity of Eastern German firms is smaller – although not significantly according to a t-test.

The average number of employees of firms with international sales grew significantly faster in the period from 1997 to 2002 compared with firms without international business activities. Exporters could, on average, realise an annualised employment growth rate of 7.7 %, whereas firms with only domestic sales grew by 2.2 % per year. Figure 5-1 depicts the estimated kernel densities of the logarithmic annualised employment growth rate. As in the case of log-labour productivity, the density functions for Germany and the UK are similar, but the estimated density of German firms' employment growth rates lies slightly to the right of the UK function. The estimated kernel densities in Figure 5-1 also emphasise that a relatively high proportion of firms has a negative employment growth rate, i.e., the firms shrank since 1997. The share of firms with a negative growth rate is higher for the UK (25 %) than for Germany (18 %).

Similarly, the annualised sales growth rate between 1997 and 2002 is significantly higher for exporters (14.6 % per year) than for non-exporting firms (8.3 %).[137] The estimated kernel density functions of the logarithmic annualised sales growth rate in Figure 5-1 show, on average, higher growth rates for German firms than for UK firms, but also a higher variance in the German sales growth rates. The share of firms with a negative sales growth rate is again higher for UK (18 %)

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[137] In order to compute the annualised sales growth rate, discounted sales were used, discounted by producer price indices (PPI). See appendix A.1 for details on the data sources used.

Figure 5-1: Estimated Kernel Densities of Each Country's Labour Productivity and Growth Rates

Log-labour productivity 2002
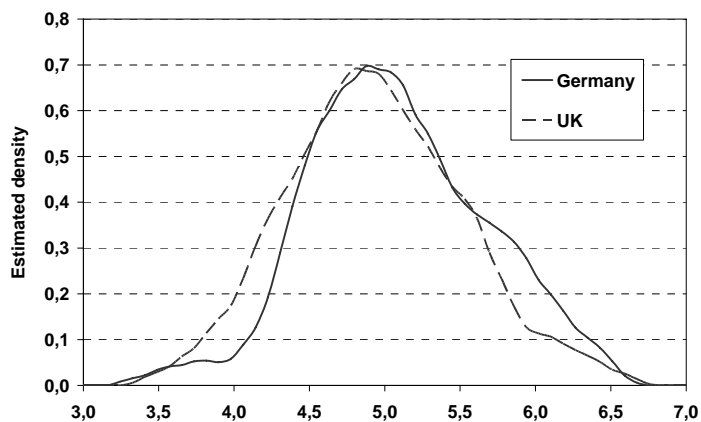
Annualised employment growth rate (log) 1997 – 2002
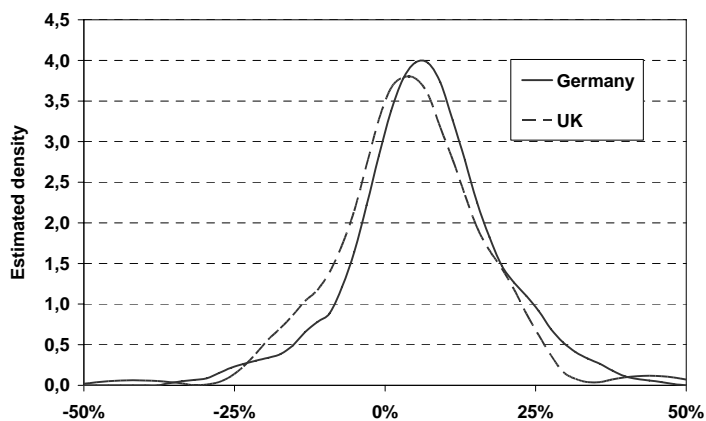
Annualised sales growth rate (log) 1997 – 2002
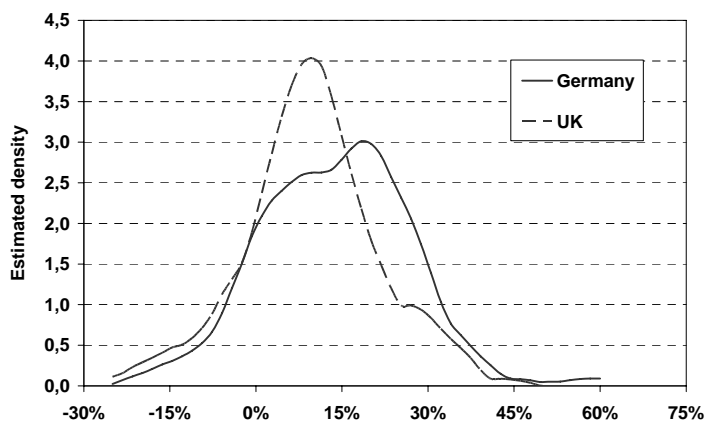
Note: Only firms that participated in both surveys were considered.

Sales growth rates were computed using discounted sales.

Labour productivity: sales in € 1,000s per non-R&D employee.

Source: ZEW, University of Exeter, own estimation.

than for German firms (12 %). To summarise, internationally active firms exhibit superior performance, measured by labour productivity, employment or sales growth, than firms with only domestic sales. Further, the performance of UK-based firms lags behind that of their German counterparts.

As is apparent, sales grew faster than the number of employees. As a consequence, labour productivity was significantly higher in 2002 in comparison with 1997. This might be a result of the turbulent macroeconomic situation in high technology markets in the period from 1997 to 2002. In order to survive, firms had to improve their productivity, firstly, by employing a given number of workers more efficiently. Secondly, as shown by the descriptive analysis above, many firms dismissed workers and reduced their total number of employees. If they dismissed the least productive employees first, labour productivity would increase. Thirdly, firms may have substituted employees by other production factors, e.g., capital or (imported) intermediate products. Thus, each unit of output can then be produced by a smaller number of employees.[138]

Comparing the annualised growth rates in the period from 1997 to 2002 with the corresponding growth rates from start-up to 1997, both the employment and sales growth rates have fallen significantly on average. This observation is in accordance with the theoretical considerations that older firms are expected to grow slower (see section 5.2). As Table 5-1 shows, in 2002 the firms in our sample are an average of about 11 years old. Whether firm age is also suitable to explain varying growth rates during the period from 1997 to 2002 is questionable and will be tested in the next section, when the firms in our sample are all examined at a later stage of their development.

5.4   Simultaneous Equation Models

The relationship between performance and internationalisation will be analysed in a two-step approach. At first, simultaneous equation models will be applied. This allows us to estimate the structural parameters of the labour productivity and the growth model as well as to determine the causal relationship between the respective indicator of firm performance and the firms' international engagement. Thereafter, I will follow more recent literature (see, e.g., Wagner 2002, Girma et al. 2002, Arnold and Hussinger 2005, De Loecker 2004) and examine the relationship between internationalisation and firm performance using matching techniques. The latter were extensively applied in the literature in evaluating labour market policies (see Lechner and Pfeiffer 2001 for an

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[138]   In computing labour productivity in 1997, I have only considered firms that participated in both surveys, i.e., firms that have survived the following six years. Therefore, the increasing labour productivity cannot be a result of the market exit of less productive firms.

overview). The matching approach estimates the causal effect by comparing the mean outcome (productivity or growth) of internationally active firms with that of a control group of domestic firms. This guarantees that non-exporting firms share similar characteristics with firms that are engaged in the international market (see section 5.5).

5.4.1 Econometric Implementation

The labour productivity model is implemented econometrically as a switching regression model with endogenous switching as described by Maddala (1983). This model allows a simultaneous estimation of the probability of internationalisation and of the determinants of labour productivity. The model is given by three equations: two level (regime) equations for productivity, dependent on the respective firm's internationalisation status (*INTS*), and a binary selection equation that determines the internationalisation status of the firm in question:

$$\ln\left(\frac{Y_i}{L_i}\right)_{INTS=1} = \ln A_{INTS=1} + \alpha_{INTS=1} \ln\left(\frac{K_i}{L_i}\right) + \beta_{INTS=1} \ln\left(\frac{R_i}{L_i}\right) + \left(\mu_{INTS=1} - 1\right)\ln L_i + u_{i,INTS=1}$$

$$(5.5) \quad \ln\left(\frac{Y_i}{L_i}\right)_{INTS=0} = \ln A_{INTS=0} + \alpha_{INTS=0} \ln\left(\frac{K_i}{L_i}\right) + \beta_{INTS=0} \ln\left(\frac{R_i}{L_i}\right) + \left(\mu_{INTS=0} - 1\right)\ln L_i + u_{i,INTS=0}.$$

$$INTS_i = \begin{cases} 1 & if\ I_i^* = d \cdot \left(\ln\left(\frac{Y_i}{L_i}\right)_{INTS=1} - \ln\left(\frac{Y_i}{L_i}\right)_{INTS=0}\right) - C_i + v_i = Z_i\xi + \varepsilon_i > 0 \\ 0 & otherwise \end{cases}$$

The latent variable I_i^* determines a firm's internationalisation decision, where C_i are the costs of international business activities per (non-R&D) employee and v_i is a normally distributed error term. The coefficient d measures the impact the gain in productivity due to international business activities has on the decision to internationalise. If d is equal to zero, the firm's export behaviour is independent of the productivity differential. The selection (read: internationalisation) equation is estimated as a reduced form. The parameter vector Z_i includes both the production factors that explain labour productivity and the variables that both influence the costs C_i of an international engagement and identify the selection equation. The error term $\varepsilon_i = d \cdot (u_{i,INTS=1} - u_{i,INTS=0}) + v_i$ is assumed to be normally distributed and the three error terms of equation system (5.5) follow a trivariate normal distribution, i.e.,

$$(5.6) \quad u \equiv \left[u_{i,INTS=0}, u_{i,INTS=1}, \varepsilon_i\right]' \sim N\left(0, \Omega\right), \quad \text{with}$$

$$(5.7) \qquad \Omega = \begin{bmatrix} \sigma_{00} & \sigma_{01} & \sigma_{0\varepsilon} \\ \sigma_{01} & \sigma_{11} & \sigma_{1\varepsilon} \\ \sigma_{0\varepsilon} & \sigma_{1\varepsilon} & 1 \end{bmatrix}.$$

$\sigma_{\varepsilon\varepsilon}$ is set to 1 due to identification. The covariance σ_{01} cannot be estimated since one single firm is only observed either in the regime with international sales (*INTS* = 1) or in the regime without international sales (*INTS* = 0) – never simultaneously in both regimes. If $\sigma_{0\varepsilon} = \sigma_{1\varepsilon} = 0$, we have a switching regression model with exogenous switching. Otherwise, we have endogenous switching (Maddala 1983, p. 284). In the former case, labour productivity is independent of status of internationalisation. A possibly observed higher productivity for firms with international sales, then, is only a result of a superior endowment with firm-specific resources.[139]

In principle, it is possible to formulate the growth equation in dependence of the internationalisation status, analogous to equation system (5.5). However, while evaluating the labour productivity equation only requires estimates of four parameters (three partial production elasticities and the integer measuring the parameter of production efficiency), the estimation of the heuristic growth equation is more demanding in that the parameter vector δ in equation (5.4) contains more than ten parameters that have to be estimated. This constitutes a problem in the regime without international sales, where we have less than 40 observations. In fact, econometric analysis proves that almost all estimated coefficients in the regime without international sales are statistically insignificant, even if the point estimations are close to the (significant) point estimates of the respective coefficients in the regime with international sales. Thus, I decided to use a unique growth equation for both regimes (with and without international sales).

Estimating the relationship between firm growth and internationalisation, the three-equation model (5.5) then reduces to a two-equation model:

$$\ln G_i = X_i \delta + \theta \cdot INTS_i + u_i$$

$$(5.8) \qquad INTS_i = \begin{cases} 1 & if \ I_i^* = d \cdot (X_i \delta) - C_i + v_i = Z_i \xi + \varepsilon_i > 0 \\ 0 & otherwise \end{cases}.$$

The two error terms u_i and $\varepsilon_i = d \cdot u_i + v_i$ are bivariate normal with mean zero and covariance matrix

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[139]   For more information see Maddala (1983) or Bertschek and Kaiser (2004). The model was estimated using the software package GAUSS, 6.0. The GAUSS code for the maximum likelihood function was written by Ulrich Kaiser and can be downloaded at http://www.ulrichkaiser.com/software.

$$(5.9) \quad \Omega = \begin{bmatrix} \sigma_{uu} & \sigma_{u\varepsilon} \\ \sigma_{u\varepsilon} & 1 \end{bmatrix},$$

where $\sigma_{\varepsilon\varepsilon}$ is again set to 1 due to identification. As before, the selection equation is estimated as a reduced form. The parameter θ measures the effect of international sales on firm growth. Since the growth equation and the internationalisation equation are estimated simultaneously, possible self-selection of firms with higher growth into the international market is considered.[140]

Both models are estimated by Full Information Maximum Likelihood (FIML).

5.4.2   Empirical Results

Labour Productivity and Exports

The estimation results for the productivity equations with and without international sales are given in Table 5-2. In the regime with exports, the coefficients of both capital intensity and intensity of R&D employees are significant. The coefficient of the number of non-R&D employees does not differ significantly from zero, indicating that constant returns to scale cannot be rejected. The implied point estimate of the partial production elasticity of labour is 0.732. The shape of the production function in the regime without international sales differs from that in the regime with exports. The null hypothesis of constant returns to scale can also not be rejected (the coefficient of the number of non-R&D employees is insignificant). However, the partial production elasticity of R&D employees is no longer significant. In the regime of non-exporting firms more than half of the firms did not carry out any R&D activities, that is, the median number of R&D employees in this group is zero (see the discussion in section 5.3). Thus, the productivity-increasing effect of R&D employees in this regime is almost negligible. Instead, the point estimates of the partial production elasticities of capital and non-R&D employees are both higher for firms without international sales than in the regime of exporting firms (point estimate of the partial production elasticity of labour in the regime without exports: 0.870). However, due to relatively large standard errors in the productivity equation for the regime without international sales these differences are not significant.

In the regime with international sales, the dummy variable for "other manufacturing industries" is positive and significant. Compared to engineering firms and the base category, software and

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[140]   Model (5.8) is also known as the treatment effects model (see Maddala 1983 or Greene 2000). The model was estimated using the software package STATA, version 8 SE.

Table 5-2: Switching Regression Estimation Results: Level Equations

	Coeff.		Std. error
Productivity equation for regime with international sales			
Log (capital intensity)	0.054	*	0.033
Log (intensity of R&D employees)	0.242	**	0.096
Log (number of non-R&D employees)	0.028		0.097
Engineering	0.252		0.165
Other manufacturing industries	0.559	***	0.161
East Germany	-0.724	***	0.147
Constant	5.344	***	0.246
$\rho_{1\varepsilon}$	-0.260		0.513
σ_{11}	0.475	***	0.041
Productivity equation for regime without international sales			
Log (capital intensity)	0.098	**	0.042
Log (intensity of R&D employees)	0.042		0.247
Log (number of non-R&D employees)	0.009		0.335
Engineering	-0.020		0.448
Other manufacturing industries	0.199		0.165
East Germany	-0.157		0.200
Constant	4.933	***	0.417
$\rho_{0\varepsilon}$	-0.230		0.653
σ_{00}	0.391	***	0.079
Wald tests for joint significance			
	χ^2		Prob > χ^2
Sector dummies with internat. sales	14.029		0.001
without internat. sales	1.510		0.470
Correlation coefficients	0.519		0.771
Wald tests for identity of coefficients			
Log (capital intensity)	0.722		0.396
Log (intensity of R&D employees)	0.586		0.444
Log (number of non-R&D employees)	0.003		0.957
Production elasticity of non-R&D empl. (γ)	0.843		0.359
Sector dummies	2.472		0.291
East Germany	5.224		0.022
Constants	0.724		0.395
Number of observations		143	
Log-likelihood		-135.330	

* 10 % level of significance; ** 5 % level of significance; *** 1 % level of significance.

Base category: a software/service firm.

Source: own estimation.

services, other manufacturing exporters exhibit higher labour productivity. In accordance with descriptive results, East German firms manifest significantly lower levels of labour productivity than their West German and UK rivals. Although this finding is in line with macroeconomic data, it might nevertheless be surprising, considering that we are examining firms that export and operate in a high-tech industry. East German firms with these characteristics should be able to realise world market prices and rents, allowing them to keep up with West German and UK firms. Note, however, that labour productivity is defined as sales per non-R&D employee. Because wages are lower in Eastern Germany (at least for non-R&D employees), firms might have substituted, for example, the production factor capital by non-R&D labour, leading statistically to a lower value for productivity.

The three dummy variables controlling for sectoral and regional differences are not significant in the regime without international sales. As already mentioned in the previous subsection, the number of observations is relatively small in this regime (only 35 for the final specification reported here). Whereas the estimations of the production function's parameters lead to plausible results, it appears to be impossible to empirically determine differences between industries and locations since there are only 5 engineering firms and 8 firms sited in Eastern Germany that belong to the regime of non-exporting firms.

The integer in the productivity equation measures the parameter of efficiency A of the Cobb-Douglas production function. The point estimate of the efficiency parameter is smaller in the regime without international sales, indicating, ceteris paribus, that the isoquants of the production function of non-exporting firms lie closer to the origin. The difference is, however, not significant.

Decisive for the causal relationship between productivity and internationalisation are the estimations of the two correlation coefficients ρ between the residuals of the regime equations and the internationalisation equation. As can be seen in Table 5-2, the two correlation coefficients are neither individually nor jointly significantly different from zero. Thus, the labour productivity equations are independent of the internationalisation equation. In other words, differences in labour productivity cannot be explained by export market participation, but are a result of a varying endowment with production factors, especially R&D, and of the distinct shape of the production function. This finding contradicts the results of Bürgel et al. (2004), who examined the same firm sample at an early stage of the firms' life cycles and found that internationalisation improves labour productivity. Hence, internationalisation may increase productivity during early stages of firm development. After firms have become established in the market and have reached a "mature" stage of their life cycles, the positive effect of internationalisation disappears.

Table 5-3:   Switching Regression Estimation Results: Selection Equation

	Coeff.		Std. error
Work experience abroad	0.760	*	0.399
Education abroad	1.089	*	0.630
Intense product customisation	-1.144	*	0.620
Log (capital intensity)	-0.091		0.097
Log (intensity of R&D employees)	0.951	***	0.312
Log (number of non-R&D employees)	1.306	***	0.330
Engineering	1.185	**	0.567
Other manufacturing industries	0.541		0.392
East Germany	0.152		0.534
Constant	-0.893	*	0.536
Wald tests for joint significance			
	χ^2		Prob $> \chi^2$
Entire set of identifiers	7.050		0.070
Factor inputs	16.498		0.001
Sector dummies	5.309		0.070
Entire productivity equation	27.212		0.000
Number of observations		143	
Log-likelihood		-135.330	

* 10 % level of significance; ** 5 % level of significance; *** 1 % level of significance.

Base category: a software/service firm.

Source: own estimation.

Table 5-3 depicts the estimation results of the switching regression model for the selection, i.e., the internationalisation equation. In order to identify the selection equation, three variables were included that are assumed to be independent of labour productivity, but that determine the firms' internationalisation decisions.[141] The international experience that the firms' managers acquired before entering their respective firms facilitates international business activities. If one member of the management team has previous work experience abroad or was educated abroad, his firm will be more likely to have international sales. This result supports Johanson and Vahlne (1990), who stated that an internationally experienced management team can overcome the uncertainty present in foreign markets, and the resource-based view of the firm that regards international experience as an intangible asset that differentiates firms from their competitors. Further, intense product cus-

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[141] I also estimated the labour productivity equation separately for the two regimes by OLS, including the three identifying variables from the selection equation. The OLS model is, in fact, appropriate, because we found that the productivity equations and the internationalisation equation are independent from one another. In the productivity equation without international sales all three identifying variables are neither individually nor jointly significant. In the regime with international business activities, only the dummy variable that indicates whether one member of the firm's management team has work experience abroad is individually significant at the five-percent level, but the three variables are nevertheless jointly insignificant on the same level of significance. Thus, the three chosen variables can be regarded as appropriate for identifying the selection equation.

tomisation is a barrier to international business activities. If a firm has to consider the special needs of each customer, this increases the costs of international engagement. These findings are completely in accordance with the previous results obtained in chapter 4. The entire set of identifying variables is jointly significant, although only on the 10 % level.

Apart from capital intensity, the production factors enter the selection equation significantly. The intensity of R&D employees and the number of non-R&D employees are positively correlated with foreign market participation. Thus, the strategic role of R&D for the export behaviour of (small) technology-oriented firms that was already highlighted in chapter 4 is confirmed by this section's model. Firm size, measured by number of non-R&D employees, also increases the probability of being an exporter. As stated in the previous chapter, larger firms possess more resources that facilitate international business activities. Finally, engineering firms are significantly more likely to have international sales compared with the other manufacturing and service sectors, and the dummy variable indicating firms that are located in Eastern Germany does not influence the probability of foreign market participation.[142]

The variables determining labour productivity are obviously also relevant for the decision to export. Since the selection equation is estimated as a reduced form, the parameter d in the selection equation of equation system (5.5) that indicates whether the productivity differential between the regimes with and without international sales has an effect on the internationalisation decision is not estimated directly. However, because the coefficients of the variables of the productivity equations are individually and jointly significant, it can be concluded that the decision on export market participation is influenced by labour productivity in the sense that more productive firms are (or will become) exporters. Thus, this study confirms the findings of many other studies (see section 5.1): The higher labour productivity of firms with international sales is a result of self-selection into the foreign market.

This is a rather sobering result, considering that the productivity-increasing role of internationalisation is often stressed by policy makers and consultants. However, firm managers themselves are not motivated by potential productivity-enhancing effects when deciding on internationalisation.

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[142] The higher probability of engineering firms having international sales contradicts the results obtained in section 4.2. The probability of foreign market entry of engineering firms is lower than that of other manufacturing firms and does not differ significantly from that of software and service firms. These contradictory results may be due to the fact that in this chapter, the status of internationalisation at the time of the second survey is examined, whereas in section 4.2 foreign market entry in the two periods from start-up to 1997 and from 1997 to 2003 is analysed. Moreover, the probability of engineering firms exiting from the international market is lower when compared with firms from other high-tech sectors. This finding is consistent with the greater probability of engineering firms being internationally engaged in 2003.

Table 5-4:   Motives for Entering the International Market 1997

	most important motive (in %)	least important motive (in %)
Potential of foreign market	74.19	7.10
Limited potential of domestic market	22.58	22.58
Amortisation of R&D costs	7.10	38.71
Learning effects	3.87	32.90
Reputation benefits	14.84	18.71

Note: Firms with international sales in 1997. Only firms that participated in both surveys were considered.

Some firms indicated more than one motive as most or least important.

Source: ZEW, London Business School.

When the firms in our sample were contacted for the first time, the firms' representatives were asked about the motives behind their international business activities. Firm managers had to rank five motives given by the questionnaire in order of importance. The ranking is illustrated by Table 5-4. Only 4 % of the firm managers indicated learning as their most important motive. On the other hand, for one-third of the respondents learning was least important. Instead, sales-oriented motivations proved to be far more essential. The limited potential of the domestic market and the expected potential of the foreign market, actually only two aspects of the same object, were cited by about 97 %[143] of the firm managers as their key reason for internationalisation. The amortisation of high research and development costs was regarded by 7 % of the firms as the most important motive. Since the amortisation of R&D costs is often only possible through fast company growth, this can also be regarded as a sales-oriented motive. Hence, sales and growth-related motivations are far more important than productivity or cost-related aspects.[144] Considering our estimation results, firm representatives do well not to expect too much from potential learning effects – at least in the long run. Whether their expectations with respect to growth effects of internationalisation are justified in the long run will be examined in the next subsection.

Growth and Exports

The estimation results of the employment growth and the sales growth models are displayed in Tables 5-5 and 5-6, respectively. The upper part contains the results of the heuristic growth equations, the lower shows the estimations for the internationalisation equations.

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[143]   Some firms indicated two or three of the five given motives as most or least important. Therefore, the percentages do not add up to 100 %.

[144]   Even reputation effects of being an internationally active firm are more important than expected learning effects. 15 % of the firms indicated their hope of an improved reputation as their most important motive.

Table 5-5: Employment Growth Model Estimation Results

	Coeff.		Std. error
Employment growth equation			
Log (number of employees t - 1)	-0.138	***	0.040
Log (number of employees t - 1) ^{2}	0.019	***	0.007
Log (age in t - 1)	-0.010		0.017
Permanent R&D activities	0.118	***	0.043
Occasional R&D activities	0.061	*	0.033
Shortage of competencies: Marketing	-0.043	**	0.020
Shortage of competencies: R&D	-0.010		0.024
Window of opportunity $\leq$ 12 months	-0.015		0.017
Engineering	0.035		0.026
Other manufacturing industries	0.022		0.022
Dummy Germany	0.024		0.017
Constant	0.183	***	0.060
International sales	*0.001*		*0.077*
ρ	0.157		0.474
σ_{uu}	0.010	***	0.006
Internationalisation equation			
Work experience abroad	0.629	**	0.294
Education abroad	0.446		0.421
Intense product customisation	-0.936	***	0.336
Log (number of employees t - 1)	0.367		0.668
Log (number of employees t - 1) ^{2}	-0.034		0.123
Log (age in t - 1)	-0.059		0.315
Permanent R&D activities	1.911	***	0.372
Occasional R&D activities	0.926	**	0.385
Shortage of competencies: Marketing	-0.040		0.337
Shortage of competencies: R&D	-0.085		0.401
Window of opportunity $\leq$ 12 months	0.571	*	0.302
Engineering	1.193	***	0.410
Other manufacturing industries	0.676	**	0.300
Dummy Germany	-0.175		0.288
Constant	-1.503		1.022
Specification tests			
	χ^2		Prob > χ^2
LR-test of independence of equations ($\rho = 0$)	0.13		0.7223
Wald test for joint significance in internat. eq.:			
Entire set of identifiers	12.78		0.0051
Entire employment growth equation	34.89		0.0003
Number of observations		175	
Log-likelihood		94.5165	

* 10 % level of significance; ** 5 % level of significance; *** 1 % level of significance.

Base category: UK software/service firm without R&D activities.

Source: own estimation.

In contrast to Gibrat's law, employment growth rate decreases with number of employees, measured at the beginning of the growth period 1997. As was the case in other empirical studies, for example, by Evans (1987a) or Almus et al. (1999), I find a non-linear, convex relationship between firm size and employment growth, indicated by the positive sign of the squared number of employees. It is, however, questionable whether the observed negative relationship between firm size and growth can be explained by firms approaching their minimum efficient scale (MES). On the one hand, there is indeed a number of firms that were founded only a few years before the onset of the growth period examined.[145] It is plausible to assume that these firms underwent growth processes in order to reach their MES. On the other hand, our sample includes firms that were ten years old in 1997. It can be expected that the latter firms had already arrived at their MES by 1997, making the negative relationship between number of employees in 1997 and employment growth unattributable to the firms' growth processes before reaching their MES. Further, we observe many firms that shrank during the growth period. For those firms the negative sign of the coefficient of number of employees means that the smaller the firm is, the slower it shrinks. Small firms that survive can only reduce their number of employees by a limited amount. Large firms can, and often have had to, reduce their number of employees significantly, probably because of decreasing demand following the high-tech market downturn in 2000.

In the sales growth equation, the coefficient of the amount of sales at the beginning of the growth period has the expected negative sign. Similarly, the coefficient of the squared sales in 1997 is positive as predicted by theory. However, neither previous sales nor squared previous sales are significant in the sales growth equation. It is not possible to determine whether there are systematic differences between employment growth and sales growth, or whether the insignificant results are due to the relatively small sample size in the sales growth equation, where we have 22 observations less than in the employment growth equation. Nevertheless, Gibrat's law cannot be rejected statistically by the results of the sales growth model. Sales growth is then determined by other variables or random effects.

The logarithm of firm age does not affect employment growth but has a negative impact on sales growth. On the basis of these mixed results, it is not clear whether the younger firms in our sample can still realise efficiency gains due to learning processes, or whether this effect has become irrelevant because most of the firms in our sample have, after all, reached a "mature" stage of their life cycles.

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[145] Remember that our sample contains firms that were founded between 1987 and 1996, inclusive. The growth period observed starts in the year of the first survey (i.e., 1997).

Table 5-6: Sales Growth Model Estimation Results

	Coeff.		Std. error
Sales growth equation			
Log (sales t - 1)	-0.105		0.094
Log (sales t - 1) ^{2}	0.006		0.007
Log (age in t - 1)	-0.044	**	0.020
Permanent R&D activities	0.049	*	0.029
Shortage of competencies: Marketing	-0.049	**	0.023
Shortage of competencies: R&D	0.013		0.027
Window of opportunity $\leq$ 12 months	-0.003		0.018
Log (age of product)	-0.026	*	0.015
Engineering	-0.044		0.028
Other manufacturing industries	-0.031		0.026
Dummy Germany	0.027		0.020
Constant	0.629	**	0.317
International sales	*0.056*		*0.057*
ρ	-0.266		0.313
σ_{uu}	0.106	***	0.006
Internationalisation equation			
Work experience abroad	0.638	**	0.304
Education abroad	0.464		0.498
Intense product customisation	-0.832	**	0.357
Log (sales t - 1)	1.498		1.536
Log (sales t - 1) ^{2}	-0.096		0.110
Log (age in t - 1)	-0.190		0.353
Permanent R&D activities	1.568	***	0.343
Shortage of competencies: Marketing	0.095		0.378
Shortage of competencies: R&D	-0.111		0.438
Window of opportunity $\leq$ 12 months	0.434		0.318
Log (age of product)	0.183		0.279
Engineering	1.016	**	0.448
Other manufacturing industries	0.832	**	0.367
Dummy Germany	-0.277		0.312
Constant	-6.237		5.203
Specification tests			
	χ^2		Prob > χ^2
LR-test of independence of equations ($\rho = 0$)	0.13		0.7169
Wald test for joint significance in internat. eq.:			
Entire set of identifiers	9.95		0.0190
Entire sales growth equation	29.79		0.0017
Number of observations		153	
Log-likelihood		71.9526	

* 10 % level of significance; ** 5 % level of significance; *** 1 % level of significance.

Base category: UK software/service firm.

Source: own estimation.

As hypothesised, R&D activities increase both a firm's employment and sales growth rates. The dummy variable for permanent R&D activities characterises firms that carried out R&D continuously during the examined growth period. Thus, the firms created intangible assets that increased their growth rates, argued in accordance with the resource-based view of the firm. Firms may even build up inimitable assets that boost their growth through occasional R&D activities, but this dummy variable is only relevant in the employment growth equation and insignificant in the sales growth equation. It was thus neglected in the final specification of the sales growth model.

The dummy variable indicating an experienced shortage of skills in marketing significantly reduces employment and sales growth. On the other hand, shortages of skills in R&D do not significantly affect growth of sales or employment. Looking at the experienced shortages of skills over time indicated by firm managers, the percentage of firms with an affirmed shortage of competencies in R&D decreased between start-up and the first survey and again between 1997 and 2003, thus reflecting learning effects with respect to technical fields like production and R&D. Therefore, growth is evidently not restricted in this way. The shortages of skills in a more sales-oriented field such as marketing also reduced between the start-up period and 1997, but between 1997 and 2003 the percentage of firms whose management teams experienced a crucial shortage rebounded. In times of growing markets and a favourable macroeconomic situation, selling one's product might be relatively easy. After the high-tech market downturn in 2000, however, the intensified competition on the high-tech market forced firms to increase their efforts to promote sales in order to ensure growth or even survival. During a period of macroeconomic stagnation, firms' products and services are no longer sold "automatically". Sales-related capabilities become more important and shortages of competencies in marketing reduce growth.

Firms with a window of opportunity that lasts 12 months or shorter do not distinguish themselves significantly from firms with longer periods of this sort. Interestingly, when analysing the firms in our sample during the growth period between start-up and 1997, dummy variables indicating a large window of opportunity significantly reduced (employment) growth rates (see Bürgel et al. 2004). Probably, in the 1990s firms could afford to grow more slowly, under today's difficult market conditions, however, firms must fully exploit competitive advantages in order to maintain market position, even if they are potentially able to profit from a relatively long competition-free period. As hypothesised, the age of a firm's best selling product negatively affects its sales growth rate, although the coefficient is only significant on the 10 % level and insignificant in the employment growth equation (and therefore not included in the final specification of the employment growth model). Firms with older and possibly out-of-date products exhibit smaller sales growth rates than firms that generate a higher share of sales with more recently developed products.

Industry-specific differences are of minor importance after controlling for the factors discussed above. Similarly, in accordance with the descriptive results depicted in Figure 5-1, the dummy variable for German firms is positive but insignificant. Thus, there are no systematic differences between German and UK firms additional to those covered by the growth models.

International sales do not affect employment or sales growth significantly. Furthermore, the estimated correlation coefficients ρ between the residuals of the growth equation and the internationalisation equation are also not significantly different from zero, making the employment growth and sales growth equations each statistically independent of the respective internationalisation equation. As in the case of labour productivity and in contrast to the expectations of the firms' managers, internationalisation does not improve firm performance (measured by employment or sales growth).

The set of identifying variables in the internationalisation equation is jointly significant. Further, the estimation results for the individual variables are similar to the labour productivity model: Firm managers having work experience abroad increase the probability of their companies being exporters, whereas high product customisation is a barrier to entry into the foreign market.[146] [147]

The variables of the growth equation are jointly significant in the corresponding internationalisation equation, thus showing that the variables determining growth also affect the internationalisation decision. Somewhat surprisingly, neither number of employees nor amount of sales is significant in the estimated reduced form of the selection equation. In most other studies, in which a measure of firm size is regressed on the probability of having international sales, the coefficient of firm size is positive and significant. My findings may be due to the fact that the number of employees and the volume of sales at the beginning of the growth period were included in the selection equation, while the endogenous variable is a firm's participation in the foreign market in 2003. Current firm size is intended to approximate the firms' current resources and thereby expected to be positively correlated with their current export activities. Over a six-year period,

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[146] In contrast to the estimation results for the labour productivity model, the dummy variable indicating whether a firm manager was educated abroad is not significant in the growth models. It is difficult to interpret why this single variable is significant in the selection equation of the labour productivity model but insignificant in that of the growth models. However, since there are two variables measuring specific human capital that facilitates international business activities and at least one dummy variable is significant, the two dummy variables should be interpreted together as reflecting one dimension of specific human capital.

[147] As with the productivity model, I estimated the two growth equations by OLS, including the three identifying variables from the selection equation. The OLS model is again appropriate, since the growth equation and the respective selection equation are independent of one another. In both OLS regressions, the three identifying variables are individually and jointly insignificant. Thus, employment and sales growth are independent of these variables.

however, firms vary in size. Firms' dimensions at the beginning of the growth period might be very different from their size at its end. Hence, there may not be a positive correlation between lagged firm size and current export activities. It is also surprising that the dummy variable indicating a short window of opportunity becomes significant in the selection equation of the employment growth model. I cannot currently offer a convincing interpretation of this effect. The higher probability of manufacturing firms being exporters, however, is plausible and in line with the descriptive results (see section 4.2).

The estimation results of the internationalisation equation particularly emphasise the crucial role of R&D activities. On the one hand, R&D activities increase the probability of exporting; on the other, they enhance employment and sales growth. This means that good firms – or, to be more precise, more innovative firms – become exporters. After considering the self-selection of the more innovative firms into the foreign market, the status of internationalisation has no marginal effect on firm growth.

5.5   Matching Approach

As an alternative to the simultaneous equation models estimated in the previous section, I will now re-examine the relationship between internationalisation and firm performance using matching techniques, which have often been applied when evaluating labour market policies (see Lechner and Pfeiffer 2001). The basic idea of a matching approach based on the model of potential outcomes by Roy (1951) and Rubin (1974) is to estimate the causal effect of a labour market programme or, as in our case, of export market participation by comparing the mean of outcomes (e.g., wage level, unemployment duration, labour productivity, or firm growth) of those individuals or firms that participated in the labour market programme or in the foreign market with the mean of outcomes of a control group of non-participants. The matching approach guarantees that the non-participating individuals or firms in the control group share similar (ideally identical) characteristics (e.g., gender, level of education, endowment with firm-specific assets) with the individuals or firms in the group of participants. If the mean outcome of the participants is still lower or higher than that of the non-participants, this effect cannot then be attributed to varying characteristics of individuals or firms but can be interpreted as a causal effect of the labour market programme or firms' export activities.

5.5.1 Econometric Implementation

Let θ^1 denote the causal effect that results from firms' international engagement:

$$(5.10) \quad \theta^1 := E\left[Y^1 - Y^0 \middle| INTS = 1\right] = E\left[Y^1 \middle| INTS = 1\right] - E\left[Y^0 \middle| INTS = 1\right],$$

where $E\left[Y^1 \middle| INTS = 1\right]$ is the expected outcome of exporting firms and $E\left[Y^0 \middle| INTS = 1\right]$ is the average counterfactual outcome the same firms would have experienced had they not exported. Since an exporting firm ($INTS = 1$) cannot be observed in the regime without international sales ($INTS = 0$), $E\left[Y^0 \middle| INTS = 1\right]$ cannot be calculated using non-experimental survey data and must therefore be estimated. Moreover, since exporting and non-exporting firms in our sample differ in various important characteristics (see Table 5-1), it is not appropriate to estimate the counterfactual outcome by the simple mean outcome of non-exporting firms. This would be possible only in the case of an experiment where the internationalisation status is randomly assigned to the firms in the sample. Otherwise, the mean outcome of non-exporting firms is a biased estimator:

$$(5.11) \quad E\left[Y^0 \middle| INTS = 1\right] \neq E\left[Y^0 \middle| INTS = 0\right].$$

In order to identify a causal effect in a non-experimental setting, Rubin (1977) introduced the conditional independence assumption (CIA):

$$(5.12) \quad Y^0 \perp INTS \middle| X = x,$$

i.e., internationalisation status and outcome are independent for firms with the same realisations x of a set of exogenous variables X. The CIA is, however, only valid if all relevant variables that simultaneously influence the outcome and the internationalisation process are known and observed in the data set. In the previous section, three simultaneous equation models of the relationship between the firms' internationalisation behaviour and the respective indicator of firm performance (labour productivity, employment growth, sales growth) were estimated. For all three models, it was possible to determine which variables explain both the level of firm performance and the probability of having international business activities. Thus, our previous results provide information that ensures the validity of CIA. However, as Lechner (1998) pointed out, it is not possible to check the validity of CIA with a formal statistical test.

In practical applications, the vector X has a relatively high dimension in order to ensure the validity of CIA. For example, the internationalisation equation of both the employment and the sales growth models derived in the previous subsection contain 14 exogenous variables (not including the integer). However, Rosenbaum and Rubin (1983) showed that the problem posed by a high

dimension of X can be avoided by using so-called balancing scores. If a function $b(x_i)$ is a balancing score, equation (5.12) becomes:

$$(5.13) \quad Y^0 \perp INTS \,|\, X = x \quad \Rightarrow \quad Y^0 \perp INTS \,|\, b(X) = b(x).$$

The function $b(x_i)$ must further meet condition (5.14):

$$(5.14) \quad E\left[INTS \,|\, b(X) = b(x)\right] = E\left[INTS \,|\, X = x\right] = \Pr(x).$$

The conditional probability of export market participation $\Pr(x)$ is also labelled as the propensity score. Finally, the vector X must not contain firm-specific characteristics for which the probability of exporting takes the values zero or one, i.e., $0 < \Pr(x) < 1$. Examples of balancing scores that are compatible with the CIA cover a wide range of measures including $b(x) = x$ and $b(x) = \Pr(x)$.

In order to interpret the results of the matching approach as causal effects, the validity of another condition is essential: Individual firms' outcomes must not be influenced by the potential foreign market participation of other firms. This condition is called SUTVA (stable unit treatment value assumption; see Angrist et al. 1996). This assumption may be problematic if regional spillover effects exist, allowing non-exporting firms to profit from other firms' exporting activities such that the latter's international business activities have a productivity or growth-increasing effect on both exporting and non-exporting companies (cf. Aitken et al. 1997).[148] In this case, it will be difficult to interpret differences in firms' performance as a result of their international engagement. However, regional spillover effects are more likely to be caused by large multinational companies than by young and small high-tech firms like those in our sample. Furthermore, the number of firms that is actually observed in our data set is relatively small and distributed throughout Germany and the UK. It is thus unlikely that the international engagement of our sample's exporters has an indirect effect on the performance of our sample's non-exporters. Nevertheless, we have to consider that our results may be biased if regional spillover effects are prevalent. However, as Lechner (1998) argued, a microeconometric analysis seems to be reasonable even if the SUTVA condition is not fulfilled, since such an analysis can at least illustrate the boundaries of the real effects.

Assuming that the CIA and SUTVA conditions are both valid, the average counterfactual outcome of the sample's exporters can be estimated in an unbiased way by the outcome of non-exporters – provided that exporters and non-exporters (i.e., the control group) have similar (ideally identical) realisations of X:

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[148] In the related literature, SUTVA is sometimes labelled as the absence of general equilibrium effects (cf. Lechner 1998) or the absence of macroeconomic effects (cf. Garfunkel et al. 1992).

(5.15) $E\left[Y^0 \middle| INTS = 1, X = x\right] = E\left[Y^0 \middle| INTS = 0, X = x\right]$.

Equation (5.10) then becomes:

(5.16) $\theta^1 := E\left[Y^1 \middle| INTS = 1, X = x\right] - E\left[Y^0 \middle| INTS = 0, X = x\right]$.

As already mentioned above, the relatively high dimension the vector X has in practical applications prohibits conditioning on X. Instead, as Rosenbaum and Rubin (1983) showed and I discussed above, it is possible to reduce the problem of multidimensionality by choosing another balancing score. The most simple matching algorithm then involves selecting for each exporting firm i a partner j from the pool of non-exporters for which the chosen balancing score is as close as possible to the related score of the exporting firm i. The balancing scores are usually obtained by initially estimating a probit model which directly calculates the propensity score (i.e., the most simple form of the balancing score) for each firm in the sample:

(5.17) $E\left[INTS_i \middle| x_i\right] = \Pr\left[INTS_i = 1 \middle| x_i\right] = \Phi\left(x_i'\hat{\beta}\right)$,

where $\Phi\left(x_i'\hat{\beta}\right)$ is the cumulated density function of the standard normal.

In the previous section, three simultaneous equation models were estimated. Each model contained an internationalisation equation through which the probability of an engagement in the foreign market was determined. Since our results showed that the internationalisation equation and the related level equation (for labour productivity or firm growth) are independent from one another, the former equation can be estimated by a simple probit model. Thus, as the first step of the matching analysis in this section, I applied a probit model to re-estimate the three internationalisation equations. Not surprisingly, the results are very similar to those in section 5.4.2 and are given in Table 5-7. It should be emphasised that in the following, I will use three different specifications of the internationalisation equation – one for each indicator of firm performance. For the CIA to be valid, the vector X must include all variables that simultaneously influence both the status of internationalisation and the measure of firm performance that constitutes the outcome variable of the related matching estimator. By design, the internationalisation equations contain all variables that determine the related level equation. Additionally, in order to identify the export decision, three dummy variables were included indicating whether a firm manager had work experience abroad before joining the company, whether he was educated abroad, and whether the firm's best-selling product required intense product customisation. The internationalisation equations are interpreted in detail in the previous subsection and will therefore not be re-examined here.

Table 5-7: Probit Estimations Results for Export Market Participation

Labour productivity model

Number of observations		143	
Log-likelihood		-48.282	
McFadden's R^2		0.393	
	Coeff.		Std. error
Work experience abroad	0.760	**	0.321
Education abroad	1.089	**	0.523
Intense product customisation	-1.144	***	0.390
Log (capital intensity)	-0.091		0.078
Log (intensity of R&D employees)	0.951	***	0.271
Log (number of non-R&D employees)	1.306	***	0.300
Engineering	1.185	***	0.441
Other manufacturing industries	0.541		0.332
East Germany	0.152		0.425
Constant	-0.893	*	0.481

Employment growth model

Number of observations		175	
Log-likelihood		-61.552	
McFadden's R^2		0.328	
Work experience abroad	0.648	**	0.280
Education abroad	0.464		0.411
Intense product customisation	-0.907	***	0.327
Log (number of employees t - 1)	0.352		0.668
Log (number of employees t - 1) ^{2}	-0.030		0.123
Log (age in t - 1)	-0.071		0.316
Permanent R&D activities	1.893	***	0.369
Occasional R&D activities	0.941	**	0.385
Shortage of competencies: Marketing	-0.061		0.329
Shortage of competencies: R&D	-0.056		0.395
Window of opportunity $\leq$ 12 months	0.583	*	0.298
Engineering	1.214	***	0.405
Other manufacturing industries	0.695	**	0.293
Dummy Germany	-0.185		0.290
Constant	-1.518		1.006

Sales growth model			
Number of observations		153	
Log-likelihood		-54.986	
McFadden's R^2		0.332	
Work experience abroad	0.609	**	0.297
Education abroad	0.497		0.498
Intense product customisation	-0.828	**	0.358
Log (sales t - 1)	1.583		1.523
Log (sales t - 1) ^{2}	-0.102		0.109
Log (age in t - 1)	-0.170		0.347
Permanent R&D activities	1.589	***	0.338
Shortage of competencies: Marketing	0.114		0.374
Shortage of competencies: R&D	-0.129		0.434
Window of opportunity $\leq$ 12 months	0.442		0.317
Log (age of product)	0.194		0.277
Engineering	0.990	**	0.441
Other manufacturing industries	0.837	**	0.368
Dummy Germany	-0.277		0.312
Constant	-6.601		5.126

* 10 % level of significance; ** 5 % level of significance; *** 1 % level of significance.

Base category: a software/service firm.

Source: own estimation.

Following Lechner (1999), I use the unbounded propensity score $x_i'\hat{\beta}$ that results from the probit estimations instead of the bounded propensity score $\Phi\left(x_i'\hat{\beta}\right)$ as the main matching variable. As Lechner (1999) argued, matching on the bounded propensity score leads to undesirable asymmetry if $\Phi\left(x_i'\hat{\beta}\right)$, i.e. the predicted probability of internationalisation, is close to 0 or 1. In our data set there are a large number of exporters whose bounded propensity score is, in fact, close to 1, supporting the decision to use the unbounded score for the matching approach in this study. Figure 5-2 depicts the estimated kernel densities of the unbounded propensity scores taken from the labour productivity model and the two growth models. It is evident that the estimated densities that relate to exporting firms always lie to the right of the densities describing the unbounded scores of firms without international sales. The latter density curves reach their global maximum at a lower unbounded propensity score than the curves of exporting firms. Most importantly, the curves do not overlap over the entire range of the unbounded propensity score. However, the matching approach is only meaningful if it is possible to find a comparable non-exporting firm for each firm with international sales. Of course, it is always possible to carry out a nearest-neighbour matching, selecting mechanically for each exporter i the non-exporting firm j for which the (unbounded)

Figure 5-2: Estimated Kernel Densities of Unbounded Propensity Scores

Labour productivity model
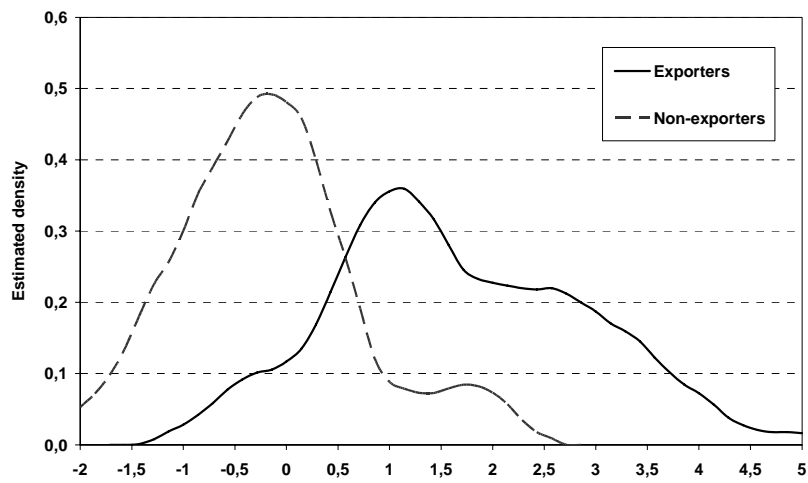
Employment growth model
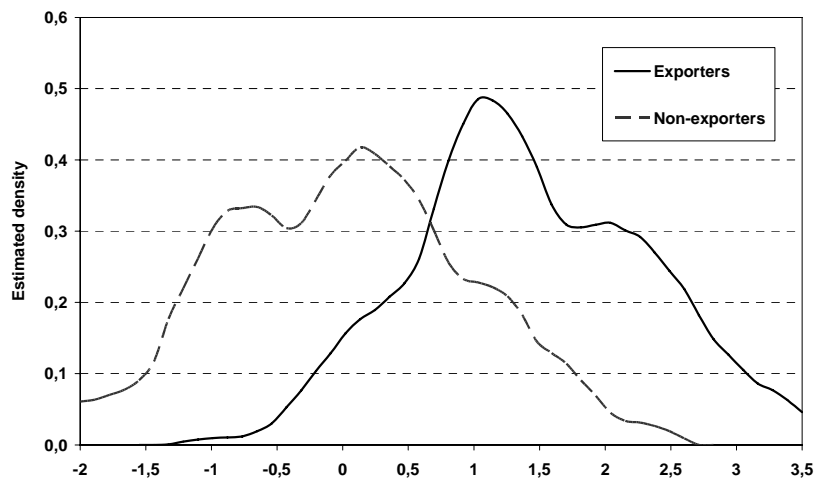
Sales growth model
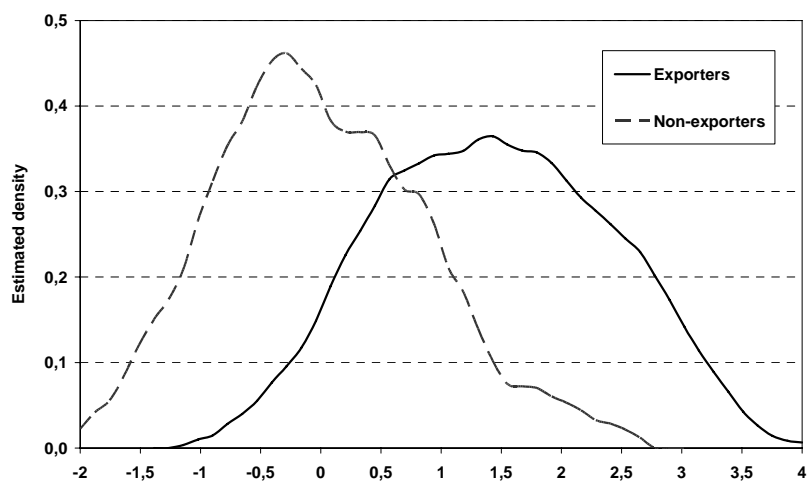
Explanations: see text.

Source: own estimation.

propensity score is closest to that of exporter *i*. However, as Heckman et al. (1997) pointed out, matches are likely to be poor if the (unbounded) propensity scores are very different for the paired firms, i.e., if the firms deviate considerably from each other with respect to their specific characteristics. Unfortunately, in non-experimental studies it is not uncommon to find that participating individuals or firms are very different from those in the non-participating subsample. As a consequence, matching analyses are generally conditioned on the support *S* shared by both the participant and control groups:

$$(5.18) \quad S = \mathrm{Supp}\left(X \,|\, INTS = 1\right) \cap \mathrm{Supp}\left(\mathrm{X} \,|\, \mathrm{INTS{=}0}\right).$$

The region of common support *S* has to be estimated if the balancing score on which the matching is conditioned is not the vector *X* but, e.g., the estimated propensity score $\hat{P}$. In this case, we have:

$$(5.19) \quad \hat{S} = \left\{ \hat{P} \in \hat{S}^1 \cap \hat{S}^0 : \quad \hat{f}\left(\hat{P} \,|\, INTS = 1\right) > 0 \quad \wedge \quad \hat{f}\left(\hat{P} \,|\, INTS = 0\right) > 0 \right\},$$

where $\hat{S}^1$ is the estimated support of participants (exporting firms) and $\hat{S}^0$ the support of non-participants; $\hat{f}$ is an estimated density at all the sample $\hat{P}$ values (Heckman et al. 1997).

Restricting the analysis to the region of common support assures the similarity of exporting firms to those from the control group. The disadvantage is, however, that the estimated causal effects are only valid for those firms in our sample of which the balancing scores belong to the region of overlapping support. As depicted in Figure 5-2, there is a relatively large number of exporting firms for which the unbounded propensity score exceeds the maximum score of the firms without international sales. For example, in the labour productivity model, 41 of 108 exporters have an unbounded propensity score that is higher than the maximum score from the group of non-exporting companies. Evaluating a job training programme, Heckman et al. (1997) compared its estimated impact using experimental data (i.e., where the common support condition is met by design) with the estimated outcome using a non-experimental data set which required a restriction on persons in the overlapping support region. Heckman et al. proved empirically that such a restriction led to a severe bias in the estimated impact of the programme. Since experiential data are, of course, not available for our study, a potential bias of the estimated causal effects cannot be avoided and has to be considered when interpreting the results.

Strictly speaking, the common support condition demands that all firms for which the balancing score does not belong to region of common support have to be excluded from the matching analyses. Since the number of observations in our data set would be relatively small even if we were able to use all responding firms for the matching analyses, I decided to retain those exporting firms

in the data set for which the estimated balancing score exceeds, but is "close" to the maximum score of firms without international sales.[149] For these internationally active firms, the non-exporting firm responsible for this maximum score should be a sufficiently appropriate match – at the least, it should not be worse than matching the non-exporting firm with the maximum score with exporters that have a slightly smaller balancing score.

Before explaining in detail the matching techniques used in this study, it has to be stressed that this study distinguishes itself from most other analyses that have also applied matching techniques (in particular, those from the field of labour economics) in an important way. Normally, there are far more non-participants in the investigated data sets than participating individuals or firms. In our data set, however, there are about three times as many firms evincing international business activities as firms with only domestic sales.[150] This will probably impede finding a similar non-exporting counterpart for each internationally active firm in our data set even if we restrict the analysis to the region of common support. Technically, it may be necessary to match a non-exporter to more than one firm with international sales (matching with replacement).

5.5.2 Results of Kernel Matching

In this study, I decided to use two different matching techniques: kernel matching and a combination of Mahalanobis distance matching and caliper matching. I will begin by discussing the results of the kernel matching approach (see Heckman et al. 1997, Heckman et al. 1998).

In contrast to nearest neighbour matching, where exactly *one* firm from the pool of non-exporters is assigned to each firm with international sales, kernel matching pairs to each exporter i a *group* D_i of similar non-exporting firms. The realised outcome of exporter i, y_i^1, is then associated with a weighted average outcome $\tilde{y}_i^0$ of all members of group D_i:

$$(5.20) \quad \tilde{y}_i^0 = \sum_{j \in D_i} w_{ij} y_j^0 \qquad \text{with} \qquad \sum_{j \in D_i} w_{ij} = 1,$$

where w_{ij} is the weight on the outcome of non-exporting firm j, y_j^0, in calculating a comparison outcome for exporter i. Kernel-based matching weights the outcome of non-exporting firms by a kernel function $K(\cdot)$ such that

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[149] What is meant by a "close" distance with respect to the balancing score is explained in detail below.

[150] Almus and Czarnitzki (2003) used matching techniques in order to evaluate the effects of public R&D subsidies on firms' innovation activities in Eastern Germany. Due to the special situation in Eastern Germany after reunification, their data set contains about twice as many firms that received subsidies as non-recipients.

$$(5.21) \quad w_{ij} = \frac{K\left(\frac{\left(x_i'\hat{\beta}\right) - \left(x_j'\hat{\beta}\right)}{h}\right)}{\sum\limits_{j \in D_j} K\left(\frac{\left(x_i'\hat{\beta}\right) - \left(x_j'\hat{\beta}\right)}{h}\right)}.$$

The kernel function depends on the chosen balancing score, i.e., in our case, the estimated unbounded propensity score; h is a predetermined bandwidth (see below). Various kernel functions could be used (e.g., Gaussian, biweight, uniform, Epanechnikov). Most of them place higher weights on non-exporters that are close to the internationally active firm i (in terms of the unbounded propensity score) and lower weights on more distant observations.[151] In this study, I used the Epanechnikov kernel function, which is defined as

$$(5.22) \quad K_{Epan}(z) = \begin{cases} 1 - z^2 & if \quad |z| < 1 \\ 0 & otherwise \end{cases}.$$

This functional form implies that only the non-exporting firms within the predetermined bandwidth h from $x_i'\hat{\beta}$ constitute the comparison group D_i:

$$(5.23) \quad D_i = \left\{ j \in \{INTS = 0\} \,\middle|\, \left|x_i'\hat{\beta} - x_j'\hat{\beta}\right| < h \right\},$$

where $\{INTS = 0\}$ is the set of all non-exporting firms in the data set. The bandwidth was set to $h = 0.6$.[152] If the absolute distance in terms of the unbounded propensity score between an exporter i and the closest non-exporting firm j is greater than the predetermined bandwidth h, there will not be any observations in the comparison group D_i and exporter i will be excluded from the causal analysis. In this way, most exporters whose unbounded propensity scores do not belong to the region of common support (i.e., the score of exporter i exceeds the maximum score of the firms without international sales) are no longer considered. Similarly, some non-exporting firms with the smallest unbounded propensity scores do not enter into any comparison group D_i and are thus also left out of the analysis of causal effects.[153] It should further be noted that for some exporters i, their

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[151] An exception is the uniform kernel function, which places an equal weight an all non-exporting firms that belong to the comparison group D_i.

[152] I chose the bandwidth arbitrarily. My results presented below are, however, sensitive neither to the size of the bandwidth nor to the kernel function applied.

[153] If a Gaussian kernel function were used, all non-exporting firms would belong to the comparison group of each internationally active firm – even though the weight of some non-exporters may be very small. Since, in contrast to the Epanechnikov function, the range of the normal density function is infinite, no firms would be excluded from the causal analysis. Thus, the Gaussian kernel function seems to be inappropriate for examining our data set.

comparison group D_i only contains one or two non-exporting firms since there are no additional firms without international sales within a bandwidth of h. This is particularly relevant for exporters with a relatively large unbounded propensity score since, as is evident in Figure 5-2, there are only a few non-exporting firms evincing high scores.

The causal effect θ^1 of international business activities on the related indicator of firm performance is consistently estimated as the difference of the mean outcome of exporters (provided that they are not excluded from the analysis) and the weighted mean outcome of matched non-exporters (the so-called "average treatment effect on the treated"):

$$(5.24) \quad \hat{\theta}^1 = \frac{1}{N^1} \left(\sum_{i=1}^{N^1} y_i^1 - \sum_{i=1}^{N^1} \tilde{y}_i^0 \right),$$

where N^1 is the number of exporting firms that are retained for the causal analysis. The results are given in Table 5-8.[154] N^0 is the unweighted number of non-exporters that enter the analysis (the weighted number is, of course, equal to N^1). The standard errors and confidence intervals of the estimated differences $\hat{\theta}^1$, i.e. the causal effects, were obtained via bootstrapping using 500 replications. The 90 % confidence intervals were estimated in two distinct ways: The upper row shows

Table 5-8:   Results of Kernel Matching

Mean outcome of exporters	(N^1)	Mean outcome of non-exporters (weighted)	(N^0)	Difference	Std. error	90 % confidence interval		
Log-labour productivity 2002								
5.034	(80)	5.037	(32)	-0.003	0.164	-0.299	0.243	(P)
						-0.272	0.267	(N)
Annualised employment growth rate (log) 1997–2002								
0.072	(127)	0.041	(36)	0.031	0.025	-0.002	0.078	(P)
						-0.010	0.071	(N)
Annualised sales growth rate (log) 1997–2002								
0.128	(107)	0.150	(33)	-0.022	0.042	-0.064	0.071	(P)
						-0.091	0.047	(N)

N: Confidence interval assuming an approximately normally distributed statistic; P: Percentiles of the bootstrap distribution.

Note: Only firms that participated in both surveys were considered.

Source: own estimation.

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[154] The results were obtained using the `psmatch2` command programmed by Edwin Leuven and Barbara Sianesi for the software package STATA, version 8.2 SE (see Sianesi 2001). The command is available online at http://ideas.repec.org/s/boc/bocode/html.

the percentiles of the bootstrap distributions, while the lower row contains confidence intervals based on the assumption of approximate normality of the bootstrap distributions. Our results are, however, the same, regardless of the method used for calculating the confidence intervals.

The main finding is quite straightforward: International business activities do not have any significant influence on the three examined indicators of firm performance. The differences between exporters' mean outcomes and the average outcomes of matched firms without international sales do not diverge significantly from zero at any conventional level. The point estimates of the differences between the labour productivity and the sales growth model are even negative, although not significantly so. Thus, the results obtained from estimating the simultaneous equation models in the previous section are confirmed when matching techniques are applied: The superior performance of exporters is a result of the self-selection of "good" firms into the international market.

Figure 5-3 displays the estimated kernel densities of the unbounded propensity scores after matching. The curves representing exporting firms differ from those depicted in Figure 5-2 by the firms which are excluded from the causal analysis since there are no non-exporting firms within the bandwidth h. The graphs indicating firms without international sales are weighted by $\sum_i w_{ij}$, with w_{ij} defined in equation (5.20). Since matching with replacement was carried out, these weights may add up to a value greater than one.

Obviously, after matching, the range of the two curves overlaps almost completely. There are still some observations in the group of exporting firms whose unbounded propensity scores are higher than the maximum score of firms without international sales. This is a result of the fact that exporting firms for which the propensity score is close to the maximum score of the control group are allowed into the causal analysis. The three curves representing the respective control group of non-exporting firms each have two local maxima. This is most apparent for the labour productivity model but also applies to the other two models. As is evident from Figure 5-2, most firms without international sales have a relatively low unbounded propensity score, centred around the left local maximum. On the other hand, there are only a few non-exporting firms that have a large unbounded propensity score. Thus, the right local maximum represents a small number of firms with high weights, since these firms are (repeatedly) matched to a relatively large number of internationally active firms.[155] Our results therefore depend to a great extent on a few observations in the control group.

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[155]   In fact, in the labour productivity model only three (!) non-exporting firms are responsible for the right local maximum.

Figure 5-3: Estimated Kernel Densities of Matched Unbounded Propensity Scores: Kernel Matching

Labour productivity model
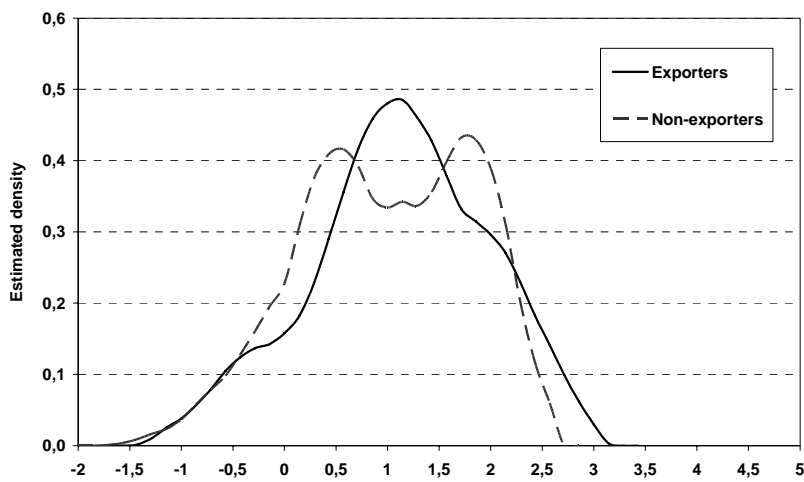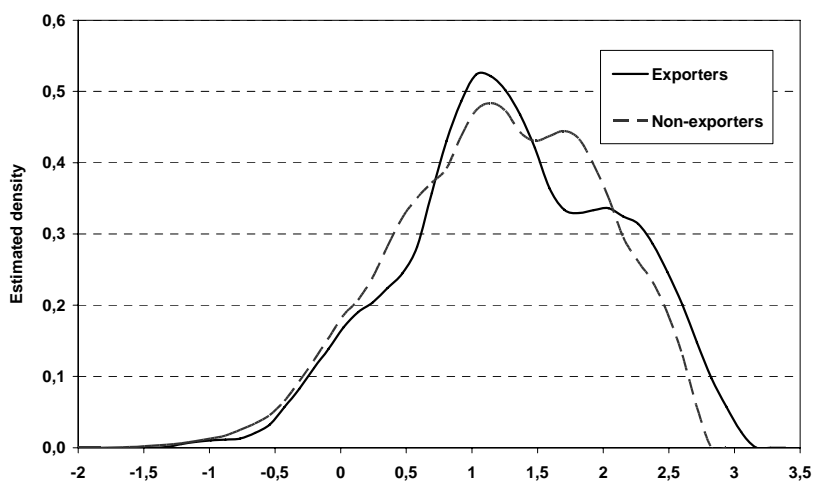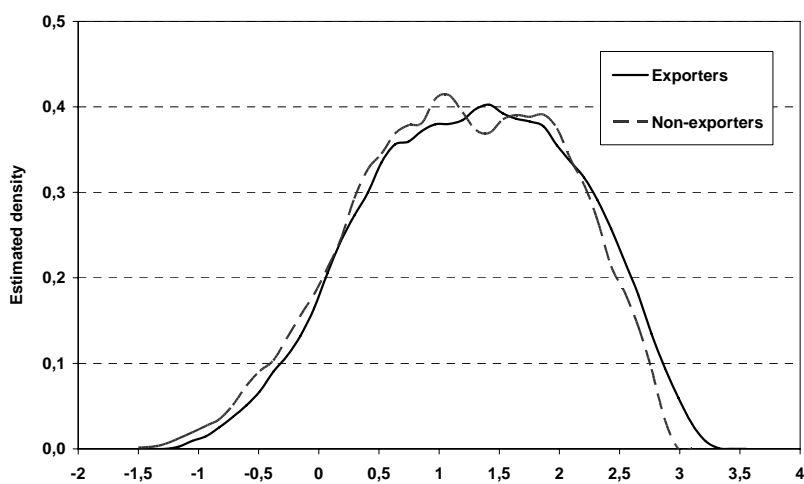
Employment growth model

Sales growth model

Estimated kernel densities of non-exporters weighted. Further explanations: see text.

Source: own estimation.

5.5.3 Results of Mahalanobis Distance Matching Within Caliper

In order to test whether my results are sensitive to different matching techniques, I applied, as an alternative to kernel matching, a combination of Mahalanobis matching (see Rubin 1980) and caliper matching (see Cochran and Rubin 1973).

The balancing score used for Mahalanobis matching is a mixture of the unbounded propensity score and a subset of X that significantly influences the probability of having international sales. The Mahalanobis distance MD_{ij} between exporter i and the non-exporting firm j is defined as

$$(5.25) \quad MD_{ij} = \left[\left(x_i'\hat{\beta}, m_i \right)' - \left(x_j'\hat{\beta}, m_j \right)' \right] COV^{-1} \left[\left(x_i'\hat{\beta}, m_i \right)' - \left(x_j'\hat{\beta}, m_j \right)' \right], \qquad \text{with}$$

$$(5.26) \quad COV = \left[\left(N^1 - 1 \right) COV^1 + \left(N^0 - 1 \right) COV^0 \right] / \left(N^1 + N^0 - 2 \right),$$

where $N^{1,0}$ is the number of exporting (non-exporting) firms and $COV^{1,0}$ is the sample covariance matrix of $\left(x'\hat{\beta}, m \right)$ in the exporting (non-exporting) subsample (cf. Rubin 1980, p. 294). m is a subset of x and contains all variables that are significant at the 1 % level according to the results of the probit estimations shown in Table 5-7. Mahalanobis matching seeks to increase the similarity of matched firms by conditioning not only on the (unbounded) propensity score but also on those variables which discriminate between exporters and non-exporters. However, regarding the labour productivity and the employment growth model, a relatively large subset of exogenous variables is significant, at least at the 10 % level. Therefore, I decided to include in the vector m only those variables that are significant at the 1 % level. On the other hand, proceeding this way means that in the sales growth model, the vector m only consists of one single variable, namely the dummy variable indicating permanent R&D activities.[156]

After calculating the Mahalanobis distance between exporter i and each firm j that did not have international sales, the firm j with the smallest Mahalanobis distance (i.e., the nearest neighbour in terms of MD_{ij}) serves as the matched control observation. In order to avoid a substantial gap between exporter i and its potential non-exporting partner j, I further combined Mahalanobis matching with caliper matching: Only those matched pairs for which the Mahalanobis distance MD_{ij} is smaller than a pre-specified tolerance d are accepted for the causal analysis. Any exporter i will be excluded from the causal analysis if the Mahalanobis distance to its nearest neighbour is

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[156] I also applied Mahalanobis matching to the sales growth model in which all variables that are significant at the 5 % level were included in the vector m. The key results concerning potential causal effects, however, are not sensitive to the specification of the vector m.

larger than d. This results in a similar effect to that of choosing a predetermined bandwidth h for kernel matching as used in the previous subsection. Only exporting firms for which it is possible to find a similar non-exporting company in terms of the balancing score used are retained for the causal analysis. The tolerance d is arbitrarily set to the 75th percentile value of the minimum Mahalanobis distances found for the sample's exporters. In this way, a quarter of exporting firms is excluded from the causal analysis. I also used the 90th and the 95th percentile values for specifying the tolerance d. The results of the causal analysis, however, do not depend on the chosen percentile value.

The estimated causal effect $\hat{\theta}^1$ is equivalent to equation (5.24). The only difference is that the outcome of exporter i, y_i^1, is no longer associated with a weighted average outcome but with the outcome of a single non-exporting firm y_i^0 (i.e., the outcome of the firm's nearest neighbour in terms of the Mahalanobis distance). The results are given in Table 5-9. They confirm the results of the estimated simultaneous equation models as well as the findings of the kernel matching analysis: There is no causal effect of international business activities on any of the three investigated indicators of firm performance. Apparently, this finding is not sensitive to the applied econometric method.

By design, only three-quarters of those exporting firms that were used to estimate the probit models for export market participation were retained for the causal analysis (see above). Interestingly, the number of non-exporting firms that were selected as the nearest available neighbour for at least

Table 5-9: Results of Mahalanobis Distance Matching Within Caliper

Mean outcome of exporters	(N^1)	Mean outcome of non-exporters	(N^0)	Difference	Std. error	90 % confidence interval		
Log-labour productivity 2002								
5.067	(81)	4.880	(20)	0.187	0.140	-0.069	0.397	(P)
						-0.044	0.418	(N)
Annualised employment growth rate (log) 1997–2002								
0.066	(102)	0.053	(22)	0.012	0.028	-0.022	0.073	(P)
						-0.034	0.058	(N)
Annualised sales growth rate (log) 1997–2002								
0.124	(88)	0.121	(19)	0.004	0.036	-0.037	0.081	(P)
						-0.056	0.063	(N)

N: Confidence interval assuming an approximately normally distributed statistic; P: Percentiles of the bootstrap distribution.
Note: Only firms that participated in both surveys were considered.
Source: own estimation.

Figure 5-4: Estimated Kernel Densities of Matched Unbounded Propensity Scores: Mahalanobis Matching

Labour productivity model
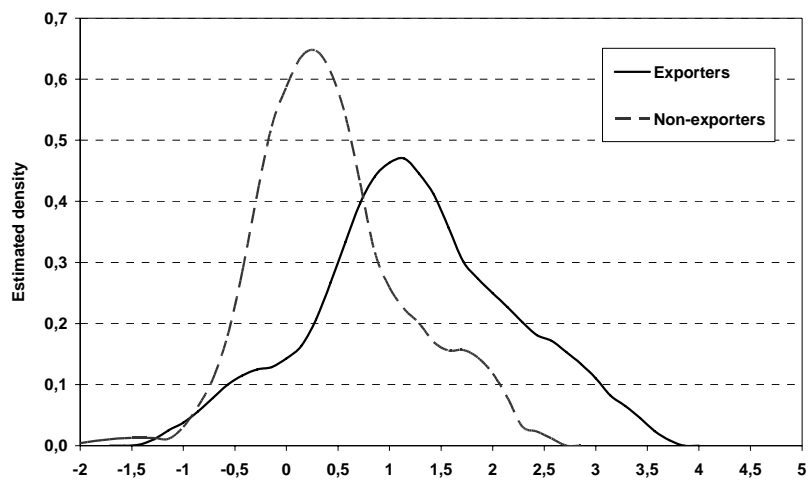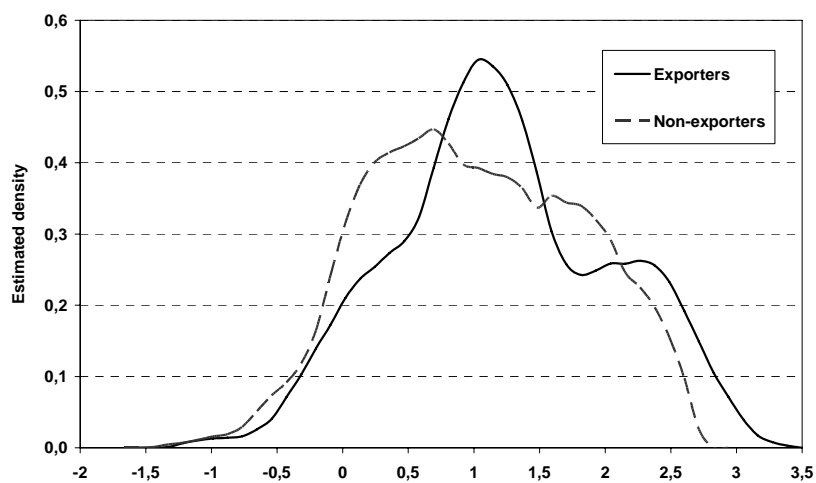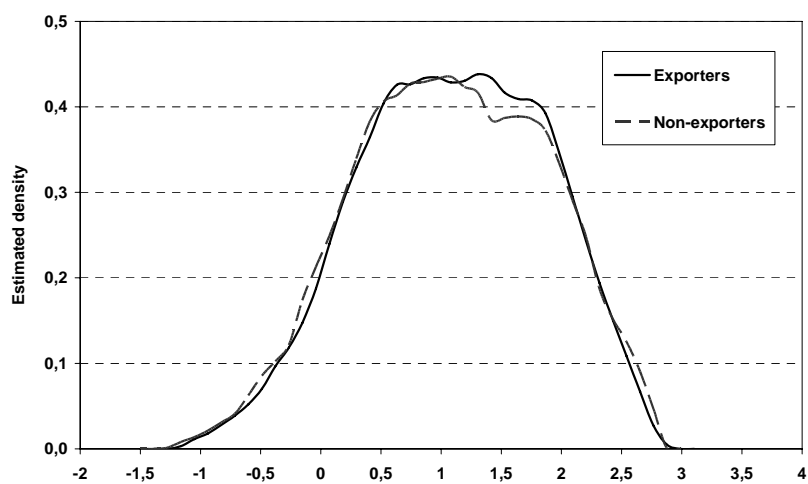
Employment growth model

Sales growth model

Estimated kernel densities of non-exporters weighted. Further explanations: see text.

Source: own estimation.

one internationally active firm is also significantly smaller than the complete pool of potential control observations. For example, in the labour productivity model the pool of non-exporting firms contains 35 observations, but only 20 were selected for the causal analysis. The Mahalanobis distance of the remaining non-exporting firms to each of our sample's exporters is relatively large, indicating that the former firms differ considerably in terms of their firm-specific characteristics from internationally active firms and are therefore not appropriate for estimating the counterfactual outcome needed for the causal analysis.

The labour productivity model also best demonstrates in which way the selection of the "most similar" non-exporting firm is influenced by explicitly considering the vector *m*, i.e., the variables which discriminate between exporters and non-exporters. Some exporting firms with relatively high unbounded propensity scores are matched to non-exporting companies with relatively small propensity scores. This is obvious from Figure 5-4, which depicts the estimated kernel densities of matched firms' propensity scores.[157] Since the unbounded propensity score is only one dimension of the balancing score used when Mahalanobis matching is applied, a larger gap in propensity score is possible, provided that the firms are similar in terms of the firm-specific characteristics included in the vector *m* (e.g., the firms' R&D activities). As is also evident in Figure 5-4, the two density curves of the sales growth model are almost identical, probably due to the fact that in the sales growth model the vector *m* contains only one variable (i.e., the dummy variable indicating permanent R&D activities). Thus, the unbounded propensity score is more important in the sales growth model for determining the nearest neighbour of each exporting firm than in the labour productivity model, where four firm-specific variables are included in the vector *m*.

5.6   Conclusion

This chapter examines the relationship between three indicators of firm performance (labour productivity, employment growth, and sales growth) and the export behaviour of our sample of young, small, technology-oriented firms in Germany and the UK. Examining the firms during an early stage of their life cycles (from start-up to 1997), Bürgel et al. (2004) showed that international business activities improved the firms' labour productivity and increased sales growth rates, but did not affect employment growth. The positive effect of internationalisation on firm performance contradicts many other empirical studies which concluded that causality runs from firm performance to internationalisation and not vice versa. Thus, the question arises whether the

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[157]   The kernel density curves of non-exporting firms in Figure 5-4 are weighted by the number of internationally active firms to which the related non-exporter is matched (recall that matching with replacement has been carried out).

results of Bürgel et al. will hold true if the firms are analysed at a later, more "mature" stage of their life cycles, or if the performance-improving effect of internationalisation is only a phenomenon prevalent during early stages of the firms' development.

My results are quite straightforward: Good firms are or will become exporters. The better performance of firms with international sales is therefore a result of self-selection of firms with superior performance into the international market. Technology-oriented firms in Germany and the UK behave exactly like the firms in most other samples studied so far. Only during the early stages of the firms' life cycles does the relationship between internationalisation and performance seem to be different. It is possible that learning effects which may increase the firms' productivity are more relevant during early stages of firm development. However, when considering a later stage of the firms' life cycles, the productivity-increasing effect disappears.

This finding is not sensitive to the econometric method applied. The estimation results of the simultaneous equation models as well as the matching approach do not find any causality that runs from the firms' internationalisation status to firm performance. However, as far as the matching approach is concerned, this conclusion is only valid for those internationally active firms for which it was possible to find a non-exporting firm with similar firm-specific characteristics, i.e. a firm without international sales, the chosen balancing score (either the unbounded propensity score or the Mahalanobis distance) of which is close to the related score of the exporting firm. Unfortunately, a relatively large number of exporters had to be excluded from the causal analysis since there is no firm without international sales in our data set which possesses similar firm-specific characteristics. Thus, our matching analysis does not provide any information of whether exporting improves the performance of those firms that had to be excluded from the analysis. Of course, the results of the simultaneous equation models are valid for all firms in our sample. Since in the latter models the partial effect of the status of internationalisation is insignificant, our analyses reject the hypothesis of a performance-improving effect of exporting for both the full sample and the reduced sample of matched firms.

This chapter's analyses further point out the crucial role R&D activities play in both the productivity and growth models as well as for the firms' (long-term) internationalisation behaviour. Firstly, the mean R&D intensity of firms in the regime without international sales decreased significantly between the two surveys, whereas firms with international sales maintained a high level of R&D activities. Secondly, R&D activities improve labour productivity as well as employment and sales growth. The number of R&D employees constitutes a production factor in the Cobb-Douglas production function. For firms with international sales, the number of R&D employees has a

productivity-increasing effect. On the other hand, in the regime of non-exporting firms, where more than half of the firms do not carry out any R&D activities, the effect of R&D employees as a production factor can almost be neglected. In this regime, the estimated partial production elasticity is not significantly different from zero. Moreover, (permanent) R&D activities boost the firms' growth rates when estimating a joint growth equation for both exporting and non-exporting firms. Finally, the more intensive a firm's R&D activities, the higher its probability of internationalisation. After controlling for R&D, there is no partial effect of internationalisation on firm performance. Hence, we can reformulate the above statement in the sense that more innovative firms self-select into the foreign market. By investing in R&D, firms create intangible assets that improve their growth prospects, increase labour productivity, and facilitate export activities with respect to both foreign market entry and long-term engagements in the international market (cf. chapter 4).

6   Summary and Conclusion

International business activities are widespread among our sample of about 200 technology-oriented firms in Germany and the UK. In 2003, 74 % of the sampled firms had international sales. At the same time, exporters generated an average of 43 % of their total sales abroad. In this study, three dimensions of firms' international engagements are examined econometrically: foreign market entry and exit, degree of internationalisation, and the change of sales modes in international markets. Moreover, the causal relationship between a firm's status of internationalisation and its performance (measured by the firm's labour productivity as well as its employment and sales growth rates) is analysed. Our results have several managerial and policy implications. Furthermore, they deliver new insights into the validity of different internationalisation theories. I will thus begin my final conclusions in this chapter with a discussion of the applicability of the theories of internationalisation presented in section 4.1 to explain the long-term export behaviour of young high-tech firms.

Validity of Internationalisation Theories

The primary objective of the dynamic model of foreign market entry and exit developed by Roberts and Tybout (1997) is to investigate the role of sunk costs and to empirically quantify their impact on firms' decisions to enter and exit the foreign market. If sunk costs are prevalent, we should observe a relatively high persistence in the firms' export participation trajectories. Since the firms in our sample have been contacted only twice, our data set is not suitable for estimating the dynamic model derived by Roberts and Tybout. Nevertheless, the descriptive analysis revealed a high persistence in the sampled firms' export activities. This finding is in line with the sunk cost hypothesis, although it is not empirical proof. Roberts and Tybout's model further predicts that a firm will leave the foreign market if expected current and discounted future profits from its international engagement are no longer positive. Hence, foreign market entry is not irreversible. Firms decide on their export activities based on factors exogenous to the firm, firm-specific characteristics, and the level of sunk (re-)entry costs. A foreign market exit as observed in our data set is thus a result of a firm maximising its current and future profits. In this study, it was possible to determine firm-specific characteristics that are decisive for foreign market entry and exit according to Roberts and Tybout's model (see the discussion below). However, our estimation results did not reveal any effect of the industry real exchange rate, the only factor exogenous to the firm that was included in the vector of explanatory variables. This finding is probably due to the small variance

of the real exchange rate and should not be interpreted as a disproof of its importance for high-tech firms' export decisions. In summary, Roberts and Tybout's model provides an appropriate framework for explaining the foreign market entry and exit of the firms in our sample. Moreover, according to Roberts and Tybout's model, a firm decides simultaneously on foreign market participation *and* its profit-maximising level of exports. Thus, Roberts and Tybout implicitly modelled a firm's decision on its optimal degree of internationalisation. The notion of this model is also helpful when examining exporters' changes of sales modes used abroad. Similarly to the firms' participation in the foreign market, there is a high persistence in chosen sales modes – probably because of sunk costs that may arise in building up a new sales channel in a foreign target market. Besides the importance of possible sunk costs, the choice of the optimal sales mode is determined by firm-specific characteristics, which are also included in Roberts and Tybout's model.

An alternative model that attempts to explain firms' long-term internationalisation behaviour is the two-period model derived by Lautanen (2000). In his model's first stage, an epidemic learning process determines which firms become interested in exporting. Since our data set does not contain information on the stimuli that lead to exporting, this part of the model could not be tested empirically. Provided that a firm has become interested in exporting in the first stage, the firm decides to commit to exporting on three conditions: that expected profits are non-negative, that it is not profitable to postpone foreign market entry, and that the firm possesses sufficient resources for its planned export activities. This study's empirical results are able to determine which firm-specific resources facilitate entry into the foreign market in the second stage of Lautanen's model.

In order to identify firm-specific variables that are likely to influence the firms' export behaviour, I used different theories of internationalisation from the field of international management. One of the most prominent theories is the internationalisation process model developed by Johanson and Vahlne (1977, 1990). Internationalisation is regarded as a gradual process in which firms incrementally increase their commitment in the foreign market. However, this model is not appropriate for explaining the international engagement of small technology-oriented firms. The very occurrence of foreign market exit contradicts the notion of the process model. Similarly, the descriptive result that firms change from direct exports to exporting via an intermediary during an early stage of their international engagement and that a transition in the other direction is observed during a later stage does not correspond to the process model. In particular, the stage models which are rooted in Johanson and Vahlne's process model predict a gradually increasing commitment in a foreign market which follows a pre-specified, deterministic path. Young high-tech firms, however, decide on their internationalisation process contingent on market conditions and the firm-specific resources they possess. With respect to the choice of the appropriate foreign sales mode, the latter

conclusion is valid at least during later stages of the firms' international engagements. At that point, firms have become established in the target market and are less dependent on the foreign partners they required during the early stages of their export activities in order to overcome the liability of alienness. This study's econometric results further show that foreign market entry and switching from an intermediary to direct exports are facilitated by firm size and the international experience of firm managers. Similarly, the probability of an exit from the foreign market is reduced by these two influencing factors. These results confirm two exceptions Johanson and Vahlne (1990) pointed out to explain in which cases firms might deviate from the gradually expanding commitment predicted by their model. For our sample's firms, the exceptions are the rule. These findings are in line with other empirical studies which emphasise that the process model is not suitable for high-tech or service firms like those included in our sample (see, e.g., O'Farrell et al. 1995, Bürgel and Murray 2000).

The importance of firm size, which approximates the amount of physical and financial resources available to the firm, is also pointed out by the resource-based view of the firm and Madhok's organisational capability (OC) perspective (cf. Madhok 1997). More essential from these theories' points of view are, however, a firm's intangible assets. Throughout this study the crucial role of a firm's R&D activities, by which a firm generates just such intangible assets, is emphasised. Intangible assets may also be incorporated into the firm's product if the firm has bought novel technologies that were developed by other companies. However, the respective dummy variable indicating the use of such a technology only positively affects the firms' degrees of internationalisation; it cannot explain foreign market entry and exit. Further, the international experience of a firm's managers constitutes an intangible asset since it represents the managers' knowledge of operating in a foreign environment, which allows the firm's product to be sold to foreign customers without a loss in value. Thus, international experience facilitates exporting and switching from exporting via an intermediary to direct exports as hypothesised by the OC perspective. Finally, it corresponds to the OC perspective that a firm will prefer an integrated sales mode if the time period for exploiting a technological advantage in a foreign market is limited (i.e., in the case of a short window of opportunity). Hence, this study verifies the hypotheses derived from the resource-based view of the firm and the OC perspective to a large extent. However, during an early stage of a high-tech firm's international engagement there are strategic and structural influences that might dominate the impact of the exporter's intangible assets. Thus, there is only weak evidence of an effect of a firm's intangible resources on the probability of changing from direct exports to exports via an intermediary.

More recently, theories of international entrepreneurship have combined models of international business and entrepreneurship. Their main focus is the acting entrepreneur who triggers the internationalisation process. Andersson (2000) distinguished between a technical entrepreneur, who is mainly interested in technology, and a marketing entrepreneur, who pro-actively creates his firm's internationalisation process. According to our empirical results, however, a distinction between different types of entrepreneurs influences neither the probability of an international engagement nor the degree of internationalisation. Admittedly, the variables that are intended to discriminate between marketing and technical entrepreneurs (i.e., the two dummy variables indicating whether firm managers experienced shortages of competencies in sales/distribution and production/R&D, respectively) are only a deficient measure. Unfortunately, there are no other variables in our data set which can operationalise different types of entrepreneurs. Thus, carrying out more profound analyses on the entrepreneurial perspective of firms' internationalisation process is left to future research.

The requirement of intense product customisation is a barrier to a firm's export activities since it induces high transaction costs prior to selling the product. Customisation complicates foreign market entry and increases the probability of an exit from the international market. Similarly, it reduces the firm's degree of internationalisation and leads to a lower probability of changing to exporting via an intermediary during an early stage of the firm's international engagement. The latter effect validates the transaction cost theory derived by Anderson and Gatignon (1986) in order to explain firms' foreign sales modes. The remaining hypotheses proposed by Anderson and Gatignon's transaction cost approach are also confirmed by our estimation results. As already shown above when discussing the validity of the resource-based view of the firm, a company's intangible assets, which are supposed to increase the necessity of an integrated sales mode, are of particular importance in explaining a change from exporting via an intermediary to direct exports. Furthermore, if the firm employs internationally experienced managers, it will be able to reduce internal uncertainty, which allows the firm to export directly to foreign customers. External uncertainty (i.e., the rank of country risk) has no individual effect on the probability of a sales mode change. Only in combination with a firm's intangible assets did we find a significantly negative, although only slight, effect on the transition probability of switching from direct exports to exports via an intermediary.

Since Dunning's OLI-framework combines elements of the other theories discussed in this chapter, the validity of these theories also proves that the OLI-framework is appropriate for explaining the international engagement of high-tech firms in Germany and the UK. Thus, ownership advantages (e.g., a firm's physical, financial, and intangible assets) and internalisation advantages (e.g.,

transaction-specific assets) are decisive for a firm's export market participation, degree of internationalisation, and choice of optimal foreign sales mode. However, there is no evidence supporting the hypothesis that locational advantages (e.g., foreign market potential) influence the sales mode selection of our sample's firms. The insignificance of target country-specific factors might be due either to the fact that most of the target countries of our sample's exporters are located in Western Europe or North America, or that the proxies used are too vague to measure target country-specific differences with respect to market potential or the target country's importance for the exporter's total sales.

Hence, it can be concluded that the resource-based view of the firm (and Madhok's organisational capability perspective, which is rooted in the resource-based view of the firm) and the transaction cost analysis theory are most suitable to derive firm-specific variables that can discriminate between exporters and non-exporters. These variables should be included in the dynamic model developed by Roberts and Tybout (1997) in order to explain the long-term internationalisation behaviour of young high-tech firms in Germany and the UK. Alternatively, relevant firm-specific variables may also be motivated by Dunning's eclectic framework. On the other hand, the internationalisation process model and entrepreneurial perspective of a firm's international engagement cannot be confirmed by our empirical results.

The second objective of this study's econometric analyses was to examine the relationship between the sampled firms' international business activities and firm performance. Investigating the firms that participated in the first survey this study is based on, Bürgel et al. (2004) showed that internationalisation improved the firms' labour productivity and increased their annualised sales growth rates between the firms' start-up periods and 1997, but did not affect employment growth. In contrast, this study revealed that the performance-enhancing effects of internationalisation are in fact restricted to early stages of the firms' life cycles and disappear when technology-oriented firms become mature. Our results are in line with many other studies: Firms exhibiting superior performance are or will become exporters.

However, the question remains: Why do firms actually enter the foreign market? What are the benefits of international engagement? Arguing that good firms become exporters is only a necessary condition for international business activities. Only firms that are endowed with (intangible) firm-specific assets, primarily created by their intensive R&D activities, are able to bear the additional costs of international engagement. But this argumentation does not constitute a sufficient condition. All of the theoretical models of individual firms' foreign market participation – for example, the dynamic model formulated by Roberts and Tybout (1997) – state that a firm will

enter the international market if the (expected) benefits of such an engagement are positive. However, like many others, this study does not ascertain any long-term benefits. A productivity-increasing effect of exporting is apparent only during early stages of young technology-oriented firms' life cycles and disappears when firms become older. Similarly, the positive influence internationalisation has on sales growth that was found in the firms' start-up periods also vanishes when the firms mature. Admittedly, these performance-enhancing effects may be extremely important for newly founded technology-based firms as a means of establishing themselves on the market. Besides these early-stage effects, however, there seem to be no long-term benefits. The sufficient condition for international engagement is not fulfilled in the long run.

Additionally, the results contradict assumptions regarding rationally behaving firms. The econometric results suggest that high labour productivity and long-term growth might be realised by a firm with only domestic sales – provided that the firm invests intensively in R&D or other firm-specific assets. If we considered the additional costs of international engagement, firms who export would not be behaving rationally because they could realise high levels of performance at a lower cost without exporting. However, our findings should not be interpreted as suggesting that firms with international sales are not behaving rationally. Firstly, in this study firm performance was operationalised as labour productivity and growth. However, Roberts and Tybout's (1997) model assumes a profit-maximising firm: A firm will have international sales if the profits the firm receives by selling its products abroad are non-negative. Thus, a firm may benefit from its international engagement by increasing profits rather than by achieving higher labour productivity or growth rates. Unfortunately, it is almost impossible to collect information on firm profits gained abroad via a telephone survey. Therefore, we do not know whether internationalisation has a profit-increasing effect. Secondly, the observed self-selection of more innovative firms might be a result of forward-looking behaviour (see Bernard and Wagner 1997, or Bernard and Jensen 1999). If firms expect that they can realise long-term growth only through an expansion onto the foreign market, they will invest in R&D in order to generate the necessary assets before becoming internationally active. In this case, we observe intensive R&D activities in a continuously growing firm with international sales. Statistically, this observation is consistent with a causality running from superior performance – due to better endowment with firm-specific assets or a more efficient exploitation of these assets – to higher probability of international engagement. Thirdly, in this study only direct effects of international business activities on the performance of exporting firms are considered. Under circumstances involving regional spillover effects, non-exporting firms might also profit from other firms' exporting activities such that international business activities have a productivity-increasing effect on both exporting and non-exporting companies. If spillover

effects exist, it will be difficult to measure productivity differences as a result of international engagement.[158] Finally, the econometric models in chapter 5 only estimate the impact of internationalisation status on firm performance. However, when examining the degree of internationalisation we find significant differences among our sample's exporters in the extent of their international engagements. At the time of the second survey, 37 % of exporting firms generated more than 50 % of their total revenues in the foreign market. On the other hand, there may be some firms in our sample which merely occasionally receive unsolicited orders from abroad. It is unlikely that such occasional exports induce any performance-enhancing effects of internationalisation. Nevertheless, the latter group of firms was classified as exporters in our econometric models. Thus, there might be some threshold value of the degree of internationalisation an exporter has to exceed in order to profit from its international engagement. As a result, we must be cautious when interpreting the econometric results of this and other studies. It is econometrically apparent that firms with superior performance self-select into the foreign market. The question of whether and how firms benefit from their export activities, however, remains unanswered.

Differences in the Firms' Export Behaviour over Time

The changing relationship between internationalisation and firm performance is one of the most outstanding findings of this study. When observing our sample of newly founded technology-based firms over a longer time period, the results we obtain are similar to those of most other studies examining data sets of mature firms in various countries. This conclusion is not restricted to the export-performance relationship, but can rather be generalised to other fields of this study's analyses. For example, during early stages of the firms' life cycles the cumulative share of internationally active firms was a continuously increasing function (cf. Bürgel et al. 2004). At the time of the first survey, it seemed that for young high-tech firms the question was not whether to internationalise, but when. Exits from the foreign market were negligible, and when extrapolating the expansion path of German and UK-based firms' international engagements observed in 1997, it could be expected that, sooner or later, all of the high-tech firms in our sample would have international sales. At the time of the second survey, however, a different picture emerges. The overall share of internationalised firms increased only slightly (from 72 % in 1997 to 74 % in 2003). However, foreign market exit has become a relevant option for those firms whose international engagements were not successful. International business activities are still widespread among our sampled firms. Nevertheless, about 15 % of the firms have never had any international sales. Thus,

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[158]   For a discussion on spillover effects of export activities see Aitken et al. (1997).

the international business activities of our sampled firms are characterised by foreign market entry *and* exit, and by a group of firms for which staying a purely domestic firm is the profit-maximising decision. This finding is in accordance with the behaviour of mature firms like those examined by Roberts and Tybout (1997) or Bernard and Jensen (2004).

Regarding the firms' degrees of internationalisation over time, we find that on average our sampled firms raised their export intensity significantly. The same is true for the number of foreign target markets in which an exporter sells its products and services. Unfortunately, the observed shift in export intensity in the period between the two surveys cannot be explained by this study's econometric analysis, but it can be interpreted as reflecting a trend towards increasing globalisation on high-tech markets. With respect to the third dimension of the firms' international business activities, i.e. change of sales modes in foreign target markets, our results demonstrate one major difference between an early stage and a "mature" stage of the firms' life cycles. In the period between foreign market entry and the 1997 survey, exporters were often forced to change from direct exports to exports via an intermediary, probably in order to overcome the liability of alienness. After the firms had become established in the foreign market, they were able to change from an intermediary to direct exports, since they were no longer reliant on a foreign partner in 2003. The transaction cost theory and the resource-based view are both relevant for explaining the latter sales mode change, whereas the theories' explanatory power is relatively small with respect to sales mode changes during early stages of the firms' international engagements. This is another example of the firms' export behaviour at the time of the second survey no longer being determined by peculiarities specific to the early stages of high-tech firms' life cycles.

Analysing the firms' growth rates over a longer time period, it turned out that both the employment and the sales growth rates in the period from 1997 to 2002 are significantly smaller than those recorded between the firms' start-up and 1997. According to theory, growth rates decrease as firms get older. For example, the high efficiency gains young firms can realise due to learning processes during early stages of their life cycles decrease as firms get older, leading to declining growth rates. Moreover, it can be expected that most of the firms in our sample have already reached their minimum efficient scale (MES). Thus, the growth rates of our sampled firms are approaching those of mature technology-based firms.

Differences Between German and UK-Based High-Tech Firms

In addition to the temporal dimension of the analysis, a second major focus of this study is the comparative dimension between German and UK-based firms. Our descriptive analyses reveal some interesting differences between German and UK firms with respect to their export behaviour. At the time of both surveys, the share of UK firms with international sales was higher than that of German firms, although the differences were not significant according to Pearson's χ^2-test. More importantly, the average number of foreign countries to which UK-based exporters sold their products and the mean export intensity of UK firms exceeded the respective values of German high-tech firms. It was argued that these differences might be due to the fact that UK firms more pro-actively exploit the sales potential of foreign markets or because German firms are less dependent on the international market because of the larger size of their domestic market. Further, UK exporters more often used exporting via an intermediary as the dominant sales mode in their three most important foreign target markets of 1997. This might either reflect that, in contrast to German firms, UK firms pro-actively seek out an appropriate foreign partner. Alternatively, it might reflect that the three most important foreign markets of UK-based exporters are relatively often non-European markets (in particular the United States and Asian markets), where cooperation with a foreign partner might be more beneficial than in the case of exports to a neighbouring European country.

At the time of the second survey, German firms exhibited superior performance when compared with their UK-based competitors. The mean labour productivity of German firms significantly exceeded that of UK firms. Similarly, in the period from 1997 to 2002 German firms realised significantly higher average employment and sales growth rates than technology-oriented firms in the UK. This is, of course, a rather worrying result for UK managers and policy makers since it indicates that UK-based high-tech firms have fallen behind their rivals in at least one other major European economy.

Unfortunately, these country-specific differences highlighted by the descriptive statistics can only partly be explained by the subsequent econometric analysis. As already pointed out in chapter 3, the relatively small number of observations in our data set inhibits a thorough econometric examination of potential differences between German and UK-based technology-oriented firms. This study's various estimation equations only contain dummy variables indicating whether each firm is located in (Western or Eastern) Germany or the UK. Such dummy variables control for systematic differences that are not covered by the empirical model. For example, in the fractional logit model in section 4.3 the two dummy variables indicating Western and Eastern German firms reveal that

the export-sales ratio of German firms is significantly smaller than that or their UK-based rivals. Presumably, the higher export intensities of British firms reflect UK managers' more pro-active export behaviour. However, the effects of such "soft" factors are indeterminable based on our data set. Another example of a country-specific effect that is not covered by our model is the significantly lower labour productivity of Eastern German firms. It was argued that Eastern German firms might have substituted the production factor labour for capital because wages paid to (non-R&D) employees are lower in Eastern Germany. Thus, the relatively low labour costs in Eastern Germany potentially led to a lower level of sales per non-R&D employees (at least in the regime of firms with international sales), reflected by a significantly negative dummy variable in the labour productivity equation. Since we do not have any information on wages paid by the firms in our sample, we cannot validate this interpretation.

In most of the estimated models, however, the country-specific dummy variables are insignificant. Thus, the observed differences between German and UK-based firms are covered by the derived econometric models. On the one hand, high-tech firms in Germany and the UK may differ from each other by a varying endowment with firm-specific resources that are found to affect the firms' internationalisation behaviour. On the other hand, the effects the exogenous variables have on the firms' export activities may vary between German and UK firms, leading to a different functional form of the regression equation. An empirical proof whether or not the individual exogenous variables influence the firms' international engagement in the same way would require country-specific estimations of this study's econometric models. Due to the limited number of observations in our data set, such country-specific estimations are impossible.

Of course we can determine in which way German and UK-based firms deviate from each other with respect to their endowments with firm-specific resources. For example, the R&D intensity of UK-based firms in 2003 was larger than that of German firms, although the difference is not significant according to a t-test (cf. Table 4-1). Moreover, the share of firms in which at least one member of the management team had experience of working abroad was also larger in the UK than in Germany. Furthermore, the share of firms whose best-selling products required intense product customisation was higher in the German subsample. These are only three firm-specific variables that possibly led to the UK firms' higher probability of entering the foreign market according to the model estimated in section 4.2. However, this interpretation is only correct if these three firm-specific resources affect the probability of foreign market entry of German and UK firms in the same way. Similarly, the firms' mean gross investment in physical capital in 2002 (i.e., our rough approximation of the firms' capital stock) was significantly smaller in the UK than in Germany. Thus, a lack of investments in physical capital might have led to reduced labour

productivity in the UK. Alternatively, German firms might have utilised their production factors more efficiently. In this case, the partial production elasticities of German firms would exceed those of UK companies. These two examples show that based on our analyses of a pooled data set of German and UK high-tech firms we can draw only limited conclusions on how technology-oriented firms in Germany and the UK are distinguished from each other with respect to the determinants of firm performance and export behaviour.

Managerial and Policy Implications

From a managerial point of view, this study contributes to answering two important questions: (i) How can a technology-oriented firm ensure a long-term international engagement? (ii) What are the prerequisites for sustaining high levels of labour productivity and growth? Our econometric results suggest that these two objectives are independent of each other. Based on this finding, we cannot advise firm managers to internationalise in order to attain a higher level of firm performance. Conversely, we are not able to determine the benefits of internationalisation for a firm. Therefore, in this concluding section it is assumed that the decision to internationalise results from firms' optimising behaviour, leaving the question of how firms actually benefit from an international engagement to future research.

This study reveals that firms' own R&D activities play a crucial role in the internationalisation process. Thus, firms that intend to enter the foreign market or are interested in establishing themselves in the international market are advised to maintain a high level of permanent in-house R&D activities. At first glance, this advice seems to be self-evident since we are examining a sample of high-tech firms. However, it was shown that in 2003, level of R&D intensity could be used to discriminate between exporters and non-exporters. This was not the case at the time of the first survey, when both internationally active firms and firms with purely domestic sales spent a comparably large amount of money on R&D activities. Reducing the level of R&D as a firm becomes older is not a consistent strategy if firm managers are interested in long-term export activities. In order to overcome the numerous obstacles that are linked with an international engagement, firms should recruit managers with high levels of international experience. Firms are advised to avoid high transaction costs, for instance, by reducing the requirement of individual client product customisation. A high level of customisation is only compatible with a long-term international engagement if a firm can sell its product to a limited number of key foreign customers that represent sufficient sales potential for the supplying firm. The choice of the appropriate sales mode may also support a long-term international engagement. Exporters of high-tech products that incorporate highly sophisticated technologies are advised to use an integrated sales mode, i.e. direct exporting.

These recommendations are admittedly not new. In particular, they are very similar to the advice given by Bürgel et al. (2004) on the basis of the first survey.[159] The variables that facilitated the firms' international business activities during early stages of their life cycles are broadly identical to those that support a long-term international engagement. There are merely some peculiarities of young firms' export activities that disappear as firms mature (e.g., young firms' need to export via an intermediary because of a prevalent liability of alienness). However, firms are well advised to adjust their internationalisation strategies regularly to changing firm-specific and macroeconomic conditions. For example, if a firm has carried out intense R&D activities and increased the degree of innovativeness in its products, it might be optimal to change its foreign sales mode from exporting via an intermediary to direct exports. It is important that the firms do not rest on their former success. If they abstain from investing in physical capital or from developing innovative, up-to-date products, this will not only make future international business activities more difficult, but will also negatively affect their performance (labour productivity and growth).[160] According to this study's results, the most promising way of ensuring a high level of firm performance in the long run is to carry out permanent in-house R&D activities. Through these, a firm creates intangible, inimitable, firm-specific assets and assures a competitive advantage over its rivals.

In the context of high-tech firms, policy makers are primarily interested in the creation of new jobs, i.e., firms' long-term employment growth. In the period from 1997 to 2002, the (surviving) firms in our sample exhibited an average annualised employment growth rate of 6.2 %. Only 22 % of the firms reduced their number of employees in this period. These are, in fact, impressive numbers, in particular if we consider the downturn on high-tech markets in 2000. Although the firms in our sample were challenged by newly founded firms entering the market – at least in the period from 1997 to 2000 – and were faced with constant or even decreasing aggregate demand in most recent years, they were nevertheless able to establish themselves in the high-tech market and hire new employees. However, in 2002 the firms in our sample employed an average of just 26 indi-

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[159] It might be argued that this finding is implied by the chosen research design. In order to cover changes of firm-specific variables, the second survey replicates the questions of the first survey. Thus, the number of firm-specific variables in our data set is limited. In particular, important variables suggested by more recently developed theories (e.g., network theory) are not included in the data set. Although it is true that we do not know whether alternative theories would lead to alternative managerial implications, it should be noted that the econometric models derived in this study fit well with the data, implying that the models are appropriate for explaining the sampled firms' export behaviour.

[160] A reduced investment in physical capital or R&D is not necessarily a result of the decision by firm managers to refrain from investing. It may also reflect a firm's financial restrictions, which were in particular prevalent for high-tech firms after the downturn on high-tech markets in 2000 (see Bank of England 2001). Although a firm may be interested in investing in physical capital or R&D, it may not be able to find the necessary funding sources for the planned investment.

viduals. The 90th percentile value amounted to just 60 employees, and even the largest firm employed a mere 370 individuals. Thus, the firms in our sample did not realise the exceptionally high long-term growth rates which would have allowed them to grow into large firms.[161] Hence, this study does not give any evidence of fast-growing, high-tech firms that have become world-class companies (like Microsoft, Cisco Systems, or SAP) and have created a huge number of new jobs. Nevertheless, most of the small and medium-sized firms in our sample also contributed to the creation of new jobs. Considering current high unemployment rates, particularly in Germany, this is a positive development. Of course, this argumentation is restricted to the direct job-creating effects of the firms in our sample. Furthermore, a successfully growing high-tech firm may squeeze its competitors out of the market, leading to job losses of those individuals so far employed by the dissolved firms. On the other hand, the sampled high-tech firms may induce job creation by their customers: If high-tech firms' products and services are integrated into their customers' production processes, this will possibly improve the customers' competitiveness, entailing job creation by the high-tech firms' customers. Thus, there are both positive and negative indirect effects on employment and the total (macroeconomic) effect is not necessarily positive.

According to this study, the superior performance of internationally active firms is a result of the self-selection of more innovative firms into the foreign market. Thus, our findings do not suggest that promoting firms' export activities will have a positive impact on firms' (employment) growth or labour productivity. Nevertheless, policy makers may be interested in promoting firms' exports (e.g., via export counselling, export subsidisation, export credits). There is almost no doubt among economists that international trade improves a country's welfare. Thus, Germany and the UK are both well advised to participate in the international division of labour. This is probably one reason why each country's government intends to promote either the foreign market entry of previous non-exporters or an expansion of exporters' volume of international sales.

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[161] According to the European Commission (2002), a "large" firm is defined as a company with 250 or more employees. Only the largest firm in our sample exceeded this threshold in 2002.

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Appendix

A.1   Sources of Secondary Data

Aggregated Sales in German Manufacturing and Service Sectors

Data of sales generated by German manufacturing plants come from the monthly reports of manufacturing plants compiled by the Federal Statistical Office. Data are obtainable online from https://www-genesis.destatis.de. They cover all plants of the German manufacturing sector with at least 20 employees. Sales data for the software and service sector were taken from VAT (value added tax) statistics annually published by the Federal Statistical Office (Statistisches Bundesamt [various years]). They comprise all firms with annual turnover exceeding € 16,620. Figures represent turnover exclusive of VAT.

Aggregated Sales in UK Manufacturing and Service Sectors

UK sales data originate from the small and medium-sized enterprise statistics of the Small Business Service Statistics Team, available at http://www.sbs.gov.uk/analytical/statistics/smestats.php. Sales exclude VAT. Turnover data of VAT registered firms and all businesses operating a Pay As You Earn (PAYE) scheme come from the Inter-Departmental Business Register (IDBR). The sales statistic covers all firms with at least one dependent employee (i.e., exclusive of sole proprietorships and partnerships comprising only the self-employed owner-managers). Unregistered businesses are all assumed to be in the smallest size class (no dependent employee). Thus, they are not included in the figures presented in chapter 2.

Country Risk

Country risk data were obtained from the "Institutional Investor Magazine", available online at http://www.institutionalinvestor.com. Country risks were ranked, with rank "1" attributed to the lowest risk level. Risk data were collected by the research team conducting the first survey in 1997 (see Bürgel et al. 2004). Thus, the data are only available for 1998.

Exchange Rates

Nominal exchange rates were taken from the historical exchange rate database of Oanda Corp., accessible at http://www.oanda.com. Consumer price indices used to calculate real exchange rates originate from Global Economic Data of EconStats, available at http://www.econstats.com.

Gross Domestic Product

Country-specific gross domestic products (GDP) are measured in US dollars at price levels and exchange rates of 2000. Data were taken from OECD Statistical Database, obtainable at http://www.oecd.org, for OECD member countries and from Global Economic Data of EconStats, available at http://www.econstats.com, for non-member countries of the OECD.

Producer Price Indices

Aggregated sales of the German and UK high-tech sectors in chapter 2 as well as firms' individual sales in chapter 5 were discounted using producer price indices (PPI). PPIs for the 3-digit NACE code of the respective manufacturing sector in Germany or 4-digit NACE code of the corresponding manufacturing sector in the UK are obtainable online from the time series services of the Federal Statistical Office of Germany (https://www-genesis.destatis.de) and the Office for National Statistics in the UK (http://www.statistics.gov.uk). Since the PPI of the 4-digit NACE code 30.02 (manufacturing of computers) was the only time series where hedonic pricing methods were applied by the UK Office for National Statistics, the PPI of the corresponding German sector was also used for the respective sector (firms) in the UK in order to avoid varying methods of PPI determination. Sales of software and service sectors (firms) were discounted using the implied deflator of gross value added of the 2-digit NACE code as available from the German Federal Statistical Office. Since comparable data were not accessible for the UK, the German deflators were also used for discounting sales data of the UK software and service sector.

A.2   Written Questionnaire used for the Mail Survey in 1997, English Version

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The Internationalisation of Young, Innovative Firms
A Study by Warwick Business School and the Zentrum für Europäische Wirtschaftsforschung

Company Profile

1. Please state the year of formation (first legal incorporation) of your company: 19 ____

   Please note: Third parties will NOT be given access to individual company data. Data will be analysed anonymously and used for research purposes only.

   If you have any queries about this survey, please contact Dr Gordon Murray or Oliver Burgel at Warwick Business School:

   Phone: 01203 523914
   Fax: 01203 524628
   E-Mail: gordon.murray@warwick.ac.uk
                  o.burgel@warwick.ac.uk
   Project Homepage: http://www.intsme.zew.de

2. Was your company founded as:
   ☐   Independent new firm
   ☐   Management buy-out
   ☐   Management buy-in
   ☐   Subsidiary of another firm
   ☐   De-merger or spin-out from an existing firm
   ☐   Other (e.g. merger), please state:
   _____

3. Please indicate the TOTAL turnover of your company:
   - in the FIRST year your company had sales.............................£ _____ Year: 19 _____
   - in your LAST financial year ....£ _____ Year: 19 _____
   - the year end forecast for your CURRENT financial year ....£ _____ Year: 19 _____

4. Does your company have any international sales?
   ☐ Yes   Indicate the share of total turnover generated by foreign sales in your LAST financial year: _____ %

   Please indicate the number of foreign countries to which you CURRENTLY sell: _____
   Name the FIRST five countries in which you had any international sales and the YEAR of market entry:
   _____
   _____

   ☐ No   Do you consider international sales as a probable option in the foreseeable future ?   ☐ Yes ☐ No

5. How many persons were/are employed by your company (including owners)?
   At the time of start-up: _____   Today: _____ *(please state in full-time equivalents)*

6. How many employees (including founders) have technical/scientific education at degree level?
   Today: _____   ☐ None

7. Does your company carry out research and development activities?
   ☐ Yes, regularly   ☐ Yes, occasionally   ☐ No

8. How much did you spend on research and development in your last financial year? _____ % of total sales

9. How many employees (including the founders) currently work exclusively or for at least 50% of their time on the development of existing and new products?
   _____ *(in full-time equivalents)*   ☐ None

Founder(s) Profile

10. How many persons were founders of the start-up?   _____
    If more than 1, had any of the founders worked together for a period of at least 6 months prior to start-up?
    ☐ Yes   ☐ No

11. Please indicate whether or not you experienced a shortage of skills at the time of start-up or today:

	Initially at start-up		Today	
	Not at all	Strongly	Not at all	Strongly
Marketing	☐—☐—☐—☐—☐		☐—☐—☐—☐—☐	
Sales / Distribution	☐—☐—☐—☐—☐		☐—☐—☐—☐—☐	
Financial Management	☐—☐—☐—☐—☐		☐—☐—☐—☐—☐	
General Management / Organisation	☐—☐—☐—☐—☐		☐—☐—☐—☐—☐	
Production, Manufacturing, Logistics	☐—☐—☐—☐—☐		☐—☐—☐—☐—☐	
Research and Development	☐—☐—☐—☐—☐		☐—☐—☐—☐—☐	

12. Please indicate if any of your founders had international experience of the following kind BEFORE you made your first international sales:
   - ☐ Work experience abroad
   - ☐ Previous work experience in the UK for an international company
   - ☐ Education abroad

13. Please indicate whether your company received any of the following forms of external finance in addition to your own funds:

(as a % of total EQUITY of the company)	Initially at start up:	To date:
Venture capital:	☐ yes: _____ %	☐ yes: _____ %
Business angels / informal investors:	☐ yes: _____ %	☐ yes: _____ %
Government / public grants:	☐ yes: _____ %	☐ yes: _____ %

Product Characteristics

Please give the following information about the *best selling* product line or product family in your LAST financial year. We define a product line/family as a series of closely related products or services (including various upgrades) whose core elements and technologies are identical. For example, a BMW 7 Series would be a particular product line, a BMW 3 Series would be another one, although there are different models (i.e. BMW 318, BMW 323) within the product line. This product line/family is subsequently referred to in the following part of the questionnaire as *"product or service"*.

14. Please indicate the share of total turnover of your best selling product in your last financial year and describe the product or service:

   Share of turnover: _____ % of sales

   Description of product: _____

   _____

15. Please indicate the year in which this product or service was first sold: 19 _____

16. Please indicate whether your product or service is a:
   - ☐ Capital good or service   ☐ Consumer good or service
   - ☐ Component for other products   ☐ Product ready to use by end-user   *(multiple answers possible)*

17. How would you best describe the innovativeness of your product or service?
   - ☐ It incorporates 'tried and tested' combinations of existing technology
   - ☐ It incorporates new combinations of existing technology
   - ☐ It incorporates novel technology that has been developed elsewhere
   - ☐ It incorporates novel technology that had to be developed specifically for this product by your company

18. Please describe key characteristics of the product / service, particularly the extent to which it requires:

	low	substantial	does not apply
Technical consultation prior to sales	☐—☐—☐—☐—☐		☐
Individual client customisation	☐—☐—☐—☐—☐		☐
Specific configuration / system requirements	☐—☐—☐—☐—☐		☐
Complex or time-consuming installation	☐—☐—☐—☐—☐		☐
Regular maintenance and/or upgrades	☐—☐—☐—☐—☐		☐
Specialised training required for front-line and sales personnel	☐—☐—☐—☐—☐		☐
Other key characteristics, please specify: _____	☐—☐—☐—☐—☐		☐

19. Please indicate the estimated time for a competitor to launch a similar product with superior performance or a product with similar performance at a lower price: _____ months

20. Please indicate whether your product or service has been:
   a) developed primarily for the domestic market   ☐ yes   ☐ no
   b) developed with the intention to sell abroad   ☐ yes   ☐ no   *(please answer both questions)*

21. How is your product or service primarily sold in your home country?
   ☐ via distributors   ☐ direct sales from headquarters   ☐ both   ☐ other, please specify: _____

22. Please indicate the intensity of competition that you encounter in the UK market:

   none   very intense
   Intensity of competition: .... ☐—☐—☐—☐—☐ ....Number of direct competitors: _____

23. Do you produce your product or service in any foreign country?
   ☐ No, only domestic production   ☐ Yes, only foreign production   ☐ Yes, foreign *and* domestic production

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☐ No, only domestic production   ☐ Yes, only foreign production   ☐ Yes, foreign *and* domestic production

If yes   Indicate the country(ies): _____

☐   via a wholly owned production subsidiary
☐   via a jointly owned production subsidiary with a local partner
☐   via a local subcontractor

24. Have you ever sold this product or service abroad?
☐ Yes
☐ No, but ANOTHER product or service is sold abroad   go to Question 33
☐ No international activities   go to Question 35

International Activities / Market Entry

In the following section, we would like to ask you about your THREE MOST IMPORTANT foreign markets for the product or service DESCRIBED ABOVE in your LAST financial year (if you have international sales in only one or two countries, please fill in only for country 1 or country 1 and 2). If you did not generate any international sales with the product described above, please do not fill out this section.

25. In how many countries did you sell this product last year? _____ countries

26. Please indicate how the sales for this product have been distributed during your LAST financial year in your domestic and three most important foreign markets: *(in % of total sales for this product)*

Domestic sales:	Foreign country 1:	Foreign country 2:	Foreign country 3:	Rest of the world:	
_____ %	_____ %	_____ %	_____ %	_____ %	= 100 %

	Foreign Country 1	Foreign Country 2	Foreign Country 3
27. Please name the country and year of market entry	_____ 19 ____	_____ 19 ____	_____ 19 ____

28. Please indicate the degree of adaptation necessary to sell this product / service abroad:

	none ... substantial	low ... substantial	low ... substantial
Technical adaptation	☐—☐—☐—☐—☐	☐—☐—☐—☐—☐	☐—☐—☐—☐—☐
Adaptation to regulatory requirements	☐—☐—☐—☐—☐	☐—☐—☐—☐—☐	☐—☐—☐—☐—☐
Packaging and sales documentation	☐—☐—☐—☐—☐	☐—☐—☐—☐—☐	☐—☐—☐—☐—☐
Other important product/service	☐—☐—☐—☐—☐	☐—☐—☐—☐—☐	☐—☐—☐—☐—☐
changes required, please specify:	_____	_____	_____

29. Please indicate the intensity of competition in the foreign country

	none ... very intense	none ... very intense	none ... very intense
	☐—☐—☐—☐—☐	☐—☐—☐—☐—☐	☐—☐—☐—☐—☐
Estimate the number of direct competitors	_____	_____	_____

30. Please indicate the sequence of entry / foreign sales modes:
(e.g. A - E, see codes below)

	first entry mode	current sales mode	first entry mode	current sales mode	first entry mode	current sales mode
	____	____	____	____	____	____

Codes for modes of sales:
A Direct exporting (to end-user)   E Foreign Sales Subsidiary (wholly owned)
B Foreign Agent (sells ad hoc on commission basis)   F Licensing
C Foreign Distributor (sells on a regular basis)   G Other sales mode, please specify:
D Foreign Sales Subsidiary (joint venture)   _____

31. Between your CURRENT sales mode and the sales mode used at FIRST market entry, did you use any intermediate stages?

	☐ Yes, please specify: _____ ☐ No	☐ Yes, please specify: _____ ☐ No	☐ Yes, please specify: _____ ☐ No

32. Do you expect to use a different sales mode in the foreseeable future? (please use the above codes)

	☐ Yes, please specify: _____ ☐ No	☐ Yes, please specify: _____ ☐ No	☐ Yes, please specify: _____ ☐ No

Opportunities and Risks of International Activities

33. Did you receive any form of government assistance provided to assist your efforts to internationalise? (e.g. export grants, use of British Embassy facilities abroad, etc.)
    ☐ No   ☐ yes   please indicate the government scheme or service below:

    _____

    _____

34. How important were the following motives in influencing your decision to sell abroad?
    Please RANK the different items in order of importance (1 = most important benefit, 5 = least important benefit)

    ____ Potential of foreign markets to generate long-term company growth
    ____ Insufficient sales potential in domestic market
    ____ Amortisation of product research and development costs
    ____ Learning from internationally leading customers, suppliers or competitors
    ____ Reputation benefits of being viewed as an internationally competitive company

35. Please indicate the level of importance of the following COSTS of engaging in international sales that you have identified:

	not present	very significant	does not apply
Costs of accessing information on foreign markets	☐—☐—☐—☐—☐		☐
Costs of identifying and forming commercial relationships	☐—☐—☐—☐—☐		☐
Costs of market-entry and setting up foreign sales channels	☐—☐—☐—☐—☐		☐
Costs of product launch in overseas markets (marketing costs)	☐—☐—☐—☐—☐		☐
Operating costs of the chosen sales mode/channel	☐—☐—☐—☐—☐		☐
Costs of monitoring foreign activities	☐—☐—☐—☐—☐		☐
Other important costs, please specify below:	☐—☐—☐—☐—☐		☐

    _____

36. What constraints have you experienced during your internationalisation process OR, for firms WITHOUT international sales, which prevent you from going abroad?
    Please RANK the different items in order of importance (1= most important constraint, 5= least important constraint)

    ____ Scarcity of management time
    ____ Limited management experience in international activities
    ____ Additional costs of foreign sales caused by country-specific AND NOT customer-specific adaptations
    ____ Increased exposure to risk
    ____ Others, please specify: _____

37. PRIOR to your FIRST international sales, did you:
    ☐   have a commitment to international sales in your business plan or forecasts?
    ☐   undertake country-specific market research?
    ☐   collaborate on research and development with foreign partners?
    ☐   already sell to a UK subsidiary of your foreign customers / distributors?

38. What led to your first international sales?
    (e.g. an unsolicited order, a contact at a trade fair, any particular event or trigger)

    _____

    _____

Thank you for your cooperation!

In order to thank responding companies for their assistance with this study, we will be sending out a summary report on the findings of our research. If you would like to receive a copy of the report, please indicate your address:

Name:		
Company Name:		
Address:		
Telephone:	Fax:	E-Mail:

Please put the completed questionnaire in the pre-printed Business Reply envelope and send it to:
Dr Gordon Murray, Marketing and Strategic Management Group, Warwick Business School, Coventry CV4 7AL

A.3 Written Questionnaire used for the Mail Survey in 1997, German Version

Internationalisierung junger, innovativer Unternehmen
Eine Studie des Zentrums für Europäische Wirtschaftsforschung und der Warwick Business School

Unternehmensprofil

> Alle Ihre Angaben werden streng vertraulich, entsprechend den gesetzlichen Bestimmungen zum Datenschutz, behandelt. Alle Daten werden nur in anonymisierter Form ausgewertet. Ihre Einzelangaben dienen nur wissenschaftlichen Zwecken und werden nicht an Dritte weitergegeben.
> Für Rückfragen und Informationen:
> Dr. Georg Licht   Telefon: 0621/1235-197
>   Telefax: 0621/1235-255
> Prof. Gordon Murray   Telefon: +44/1203-523914
> Projekt-Homepage: http://www.intsme.zew.de

1. Seit wann existiert Ihr Unternehmen in der jetzigen Rechtsform?   19_____

2. Handelt es sich bei Ihrem Unternehmen um
   ☐ eine Neugründung
   ☐ ein Management buy-out (MBO)
   ☐ ein Management buy-in (MBI)
   ☐ eine Niederlassung/Zweigstelle eines anderen Unternehmens
   ☐ Outsourcing aus einem bestehenden Unternehmen
   ☐ Sonstiges, bitte angeben:_____

3. Der Umsatz Ihres Unternehmens betrug
   im Jahr Ihres ERSTEN Umsatzes?   _____ DM   Geschäftsjahr: _____
   im VERGANGENEN Geschäftsjahr?   _____ DM   Geschäftsjahr: _____
   Für das laufende Geschäftsjahr erwarten wir einen Umsatz von   ca. _____ DM

4. Erzielt Ihr Unternehmen Umsätze im Ausland?
   ☐ Ja ⇒ Wieviel Prozent des Umsatzes des letzten Geschäftsjahres erzielten Sie im Ausland? _____ %
            In wie vielen Ländern (abgesehen vom Inland) waren Sie dabei tätig?   _____
            Welches waren die ersten fünf Länder und das jeweilige Jahr der Aufnahme Ihrer Geschäfts-
            tätigkeit im Ausland?_____
            _____
   ☐ Nein ⇒ Ziehen Sie internationale Aktivitäten in absehbarer Zeit in Erwägung?   ☐ Ja ☐ Nein

5. Wie viele Mitarbeiter arbeiten in Ihrem Unternehmen? (Unternehmer eingeschlossen)
   Heute: _____   Zum Gründungszeitpunkt: _____   *(Bitte in Vollzeitstellen umrechnen)*

6. Wie viele Ihrer derzeitigen Mitarbeiter (einschließlich Unternehmensgründer) besitzen eine abgeschlossene technische/naturwissenschaftliche Hochschulausbildung (Fachhochschule, Technische Hochschule bzw. Universität)?   Anzahl: _____   ☐ Keine / keiner

7. Führt Ihr Unternehmen Forschungs- und Entwicklungs-Aktivitäten (FuE) durch?
   ☐ Ja, kontinuierlich   ☐ Ja, gelegentlich   ☐ Nein

8. Bitte schätzen Sie Ihre FuE-Ausgaben im letzten Geschäftsjahr?   _____ % des Gesamtumsatzes

9. Wie viele Mitarbeiter sind derzeit in Ihrem Unternehmen mindestens 50% ihrer Arbeitszeit mit der (Weiter-) Entwicklung existierender bzw. neuer Produkte beschäftigt?
   Anzahl: _____   *(Bitte in Vollzeitstellen umrechnen)*   ☐ Keine / keiner

Gründung und Management

10. Wie viele Unternehmensgründer gab es? _____
    Wenn mehrere: Haben einige der Unternehmensgründer vorher schon mind. 6 Monate zusammen-gearbeitet?   ☐ Ja   ☐ Nein

11. Verfügte einer der Gründer bereits über internationale Erfahrungen folgender Form BEVOR Sie auf Auslandsmärkten tätig wurden?
    ☐ Arbeitserfahrung im Ausland
    ☐ Arbeitserfahrung in einem international tätigen Unternehmen (im Inland)
    ☐ Ausbildung im Ausland

12. Bitte beurteilen Sie, inwieweit ein Mangel an Know-how das Erreichen Ihrer unternehmerischen Ziele beeinträchtigt hat bzw. heute noch beeinträchtigt:

	Zum Gründungszeitpunkt						Heute					
	überhaupt nicht				erheblich		überhaupt nicht				erheblich	
Marketing	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	
Verkauf/Vertrieb	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	
Finanzmanagement	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	
Organisation/Führung	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	
Produktion/Logistik	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	
Forschung/Entwicklung	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	

13. Bitte geben Sie an, welche der folgenden Finanzierungsformen Ihr Unternehmen über das von Ihnen eingebrachte Kapital erhalten hat?

(in % am Eigenkapital)	Zum Gründungszeitpunkt	Heute
Risikokapital (Venture Capital):	☐ Ja _____ %	☐ Ja _____ %
Privatinvestoren ("business angels"):	☐ Ja _____ %	☐ Ja _____ %
Öffentliche Fördermittel (z.B. Eigenkapitalhilfe):	☐ Ja _____ %	☐ Ja _____ %

Produkteigenschaften

Bitte geben Sie uns im folgenden Informationen zu Ihrer Im LETZTEN GESCHÄFTSJAHR UMSATZSTÄRKSTEN Produktlinie/-familie an. **Hinweis:** *Z.B. gehören hierbei alle Modelle des VW Polo einer Produktlinie an, der VW Passat zählt jedoch zu einer anderen Produktlinie. Im folgenden bezieht sich die Bezeichnung "Produkt" auf die eben definierte Produktlinie/-familie. Im Rahmen dieser Befragung fassen wir* **auch Dienstleistungen** *(z.B. Dienstleistungen über das Internet) als Produkte auf.*

14. Bitte geben Sie den Anteil Ihres umsatzstärksten Produkts am Gesamtumsatz an und beschreiben Sie kurz dieses Produkt:

Umsatzanteil: _____ *(in % am Gesamtumsatz)*

Kurzbeschreibung: _____
_____

15. Wann wurde dieses Produkt auf dem Markt eingeführt?   Jahr: 19_____   Quartal:_____

16. Das Produkt ist   ☐ ein Investitionsgut   ☐ ein Konsumgut
                       ☐ ein Zwischenprodukt   ☐ ein Endprodukt   *(Mehrfachnennungen möglich)*

17. Ihr Produkt besteht ☐ aus einer bewährten Kombination vorhandener Technologien
                        ☐ aus einer neuen Kombination vorhandener Technologien
                        ☐ aus neuen Technologien, die von Dritten entwickelt wurden
                        ☐ aus Technologien, die von Ihnen speziell für dieses Produkt entwickelt wurden

18. Die wesentlichen Eigenschaften Ihres Produkts erfordern

	gering				hoch		trifft nicht zu
Spezifische Verkaufsberatung	☐	☐	☐	☐	☐		☐
Kundenspezifischen Anpassungsaufwand	☐	☐	☐	☐	☐		☐
Spezifische Konfiguration/Systemvoraussetzung	☐	☐	☐	☐	☐		☐
Installationsaufwand	☐	☐	☐	☐	☐		☐
Regelmäßige Wartung/Update	☐	☐	☐	☐	☐		☐
Spezifische Schulung des Vertriebs- u. Verkaufspersonals	☐	☐	☐	☐	☐		☐
Sonstiges, bitte angeben: _____	☐	☐	☐	☐	☐		☐

19. Schätzen Sie bitte den Zeitraum, den ein Wettbewerber benötigt, um ein vergleichbares Produkt mit höherer Leistungsfähigkeit oder zu geringeren Kosten anzubieten!   _____ Monate

20. Wurde dieses Produkt   a. hauptsächlich für den Inlandsmarkt entwickelt?   ☐ Ja   ☐ Nein
                            b. mit der Zielrichtung auf internationale Märkte entwickelt? ☐ Ja   ☐ Nein

21. Wie vertreiben Sie Ihr Produkt hauptsächlich auf dem Heimatmarkt?
    ☐ Zwischenhändler/Handel   ☐ Direktverkauf   ☐ Beides   ☐ Sonstiges: _____

22. Wo wird Ihr Produkt produziert?
☐ Ausschließlich im Inland ☐ Ausschließlich im Ausland ☐ Sowohl im Inland als auch im Ausland

23. Haben Sie dieses Produkt bereits im Ausland verkauft?
☐ Ja
☐ Nein, aber andere Produkte *(Weiter mit Frage 31)*
☐ Nein, keine internationale Geschäftstätigkeit *(Weiter mit Frage 33)*

Wege zum Auslandsmarkt

Im folgenden Abschnitt stellen wir Ihnen Fragen über die drei IM LETZTEN GESCHÄFTSJAHR umsatzstärksten Exportmärkte/ -länder, auf denen Sie Ihr OBEN BESCHRIEBENES PRODUKT verkaufen (Falls Sie nur in einem bzw. zwei Auslandsmärkten tätig sind, so beantworten Sie die Fragen bitte entsprechend.)

24. In wie vielen Ländern verkaufen Sie dieses Produkt? _____

25. Die Umsätze Ihres umsatzstärksten Produkts verteilen sich im letzten Geschäftsjahr zu
_____% auf den Heimatmarkt
_____% auf den wichtigsten Auslandsmarkt
_____% auf den zweitwichtigsten Auslandsmarkt
_____% auf den drittwichtigsten Auslandsmarkt
_____% auf die übrigen Auslandsmärkte
= 100 % (Summe der Anteile)

26. Nennen Sie Ihre drei umsatzstärksten Auslandsmärkte:

	Land 1:	Land 2:	Land 3:
	_____	_____	_____
Jahr des Markteintritts:	19_____	19_____	19_____

27. Wie hoch war das Ausmaß der erforderlichen Anpassung, um Ihr Produkt im Ausland zu vermarkten?

	Land 1: gering — hoch	Land 2: gering — hoch	Land 3: gering — hoch
Technische Anpassung	☐–☐–☐–☐–☐	☐–☐–☐–☐–☐	☐–☐–☐–☐–☐
Anpassung wg. Zulassungsvorschriften	☐–☐–☐–☐–☐	☐–☐–☐–☐–☐	☐–☐–☐–☐–☐
Verpackungs-/Verkaufspapiere	☐–☐–☐–☐–☐	☐–☐–☐–☐–☐	☐–☐–☐–☐–☐
Sonstige: _____	☐–☐–☐–☐–☐	☐–☐–☐–☐–☐	☐–☐–☐–☐–☐

28. Beschreiben Sie die verwendete Vertriebsform für Ihr Auslandsgeschäft (z.B. A, E)

	Land 1: Erste Vertriebsform / Gegenwärtig	Land 2: Erste Vertriebsform / Gegenwärtig	Land 3: Erste Vertriebsform / Gegenwärtig
	____ ____	____ ____	____ ____

Vertriebsformen bitte mit folgenden Buchstaben benennen:
A Direktexport (zum Endverbraucher)
B Über ausländischen Handelsvertreter (auf Kommissionsbasis)
C Über ausländische Händler
D Handelsniederlassung im Ausland mit Beteiligung Dritter
E Eigene Handelsniederlassung im Ausland ohne Beteiligung Dritter
F Lizenzvergabe
G Sonstiges, bitte angeben: _____

29. Haben Sie zwischenzeitlich auch andere der oben angegebenen Vertriebsformen für den Absatz dieses Produkts im Ausland benutzt?

	Land 1:	Land 2:	Land 3:
	☐ Nein	☐ Nein	☐ Nein
	☐ Ja: Welche?_____	☐ Ja: Welche?_____	☐ Ja: Welche?_____

30. Erwarten Sie, daß Sie in absehbarer Zeit eine andere Vertriebsform benutzen?

	Land 1:	Land 2:	Land 3:
	☐ Nein	☐ Nein	☐ Nein
	☐ Ja: Welche?_____	☐ Ja: Welche?_____	☐ Ja: Welche?_____

Chancen und Risiken im Auslandsgeschäft

31. Erhielten Sie speziell für Ihre internationalen Geschäftätigkeiten öffentliche Fördermittel bzw. Unterstützung durch staatliche Institutionen (z.B. Bürgschaften, Beratung)? ☐ Ja ☐ Nein
    Wenn ja, welche: _____

32. Wie wichtig waren Ihnen die folgenden Beweggründe für die Aufnahme Ihrer INTERNATIONALEN Geschäftätigkeit? Bitte bringen Sie diese Beweggründe in eine Rangfolge. Benutzen Sie dazu die Ziffern 1 (= wichtigster Grund) bis 5 (= geringster Beweggrund)
    ___ Unternehmerisches Wachstum/Expansion
    ___ Begrenztes Potential der Heimatmarktes
    ___ Deckung der Produktentwicklungskosten
    ___ Lerneffekte durch die Nähe zu führenden ausländischen Kunden, Zulieferern und Wettbewerbern
    ___ Reputationsgewinn durch internationale Wettbewerbsfähigkeit

33. Bitte beurteilen Sie die Höhe der zusätzlichen Kosten, die Ihnen durch eine Geschäftätigkeit im Ausland entstanden sind bzw. entstehen würden:

	gering			hoch		trifft nicht zu
Kosten des Zugangs zu Marktinformationen	☐	☐	☐	☐	☐	☐
Kosten des Aufbaus von Geschäftsbeziehungen	☐	☐	☐	☐	☐	☐
Einmalige Kosten des Vertriebsaufbaus	☐	☐	☐	☐	☐	☐
Einmalige Kosten der Produkteinführung (Werbung)	☐	☐	☐	☐	☐	☐
Laufende Vertriebskosten	☐	☐	☐	☐	☐	☐
Kosten für die Überwachung der Auslandsaktivität	☐	☐	☐	☐	☐	☐
Sonstige Kosten	☐	☐	☐	☐	☐	☐

34. Was sind die größten Hindernisse bei Ihrer INTERNATIONALEN Tätigkeit bzw. aufgrund welcher Hindernisse sind Sie nicht international tätig?
    Bitte bringen Sie diese Hindernisse in eine Rangfolge. Benutzen Sie dazu die Ziffern 1 (= größtes Hindernis) bis 6 (= geringstes Hindernis)
    ___ mangelnde Zeit des Managements
    ___ mangelnde Erfahrung des Managements
    ___ zusätzliche Kosten (generell durch Auslandsgeschäft und NICHT durch einzelne Kunden)
    ___ hohe Risiken im Auslandsgeschäft
    ___ Sonstiges, bitte angeben: _____

35. VOR Ihrer ERSTEN Geschäftätigkeit im Ausland haben Sie:
    ☐ internationale Aktivitäten in Ihrer Unternehmensplanung als Ziel aufgenommen
    ☐ länderspezifische Marktforschung durchgeführt
    ☐ gemeinsam mit ausländischen Partnern an der Entwicklung Ihrer Produkte gearbeitet
    ☐ Geschäftskontakte im Inland mit einer Niederlassung Ihren ausländischen Kunden unterhalten

36. Wie kam es zur Aufnahme Ihrer ERSTEN Auslandsaktivitäten? (Z.B. Kunden-/ Händleranfrage, Messekontakt, bestimmtes auslösendes Moment) _____
    _____
    _____

Vielen Dank für Ihre wertvolle Mitarbeit !

Als kleine Anerkennung für Ihre Bereitschaft, sich an dieser Studie zu beteiligen, erstellen wir für die Teilnehmer einen zusammenfassenden Ergebnisbericht. Bitte vermerken Sie, an wen wir den Ergebnisbericht schicken sollen.

Bitte senden Sie mir den Ergebnisbericht zu ☐ Ja ☐ Nein

Name:		
Postanschrift:		
Funktion:		
Telefon:	Telefax:	E-Mail:

Den ausgefüllten Fragebogen schicken Sie bitte im beigefügten Rückumschlag an:
ZEW, z.Hd. Dr. Georg Licht, Postfach 10 34 43, D-68034 Mannheim

A.4 Questionnaire used for the Telephone Interviews in 2003, English Version

No.	Introduction		continue with No.
1	**Good morning/Good afternoon. My name is ....** **I am calling on behalf of Professor Murray from the University of Exeter. We recently wrote to your company about an international survey of high tech firms which we are undertaking. Can I please speak to the owner of your company or to the managing director.** *Int.: Repeat this introduction until the right person is on the phone.*		
	Start interview	☐	**1A**
	Wrong connection	☐	
	Refuse	☐	
	Firm was already surveyed.	☐	**block firm**
	Firm doesn't belong to target group.	☐	
	Firm dead/in dissolution	☐	
	No interview possible for other reasons	☐	
	Answering machine/no connection/busy etc.	☐	**retry later**
	OPTIONAL: *Int.: Please note the date and the time the interviewee suggests for the interview.* **date** [＿＿＿＿] **time** [＿＿＿＿] OPTIONAL: *Written questionnaire to be sent:* ☐		
1A	*Int.: Please note down the name of the interviewee!*		
1B	**We are currently undertaking academic research on British and German high tech firms. This survey builds on research originally conducted in Autumn 1997 in which your company also participated.** **We seek to identify the key factors which are associated with the continued growth and development of high tech firms founded some 10 years ago. We would particularly like to ask you some questions about your company, including possible factors that you believe may constrain or assist the growth of your company.** **It is very important for us to be able to understand the changing circumstances that high tech firms have experienced over time. For this reason we are especially interested in making contact with those firms who participated in our 1997 survey.** **Can I stress that all information will be treated with absolute confidentiality. All survey answers are aggregated and no individual firm can be identified.** **Our questions will take 20 minutes to answer. Do you have time now for a telephone interview or when would be a more convenient time for you?**		
	Continue interview	☐	**2**
	Wrong connection	☐	
	Refuse	☐	
	Firm was already surveyed.	☐	**block firm**
	Firm doesn't belong to target group.	☐	
	No interview possible for other reasons	☐	
	OPTIONAL: *Int.: Please note the date and the time the interviewee suggests for the interview.* **date** [＿＿＿＿] **time** [＿＿＿＿] OPTIONAL: *Written questionnaire to be sent:* ☐		
1C	*Hint for programming: Starting window for RESTART.* **Good morning/Good afternoon Mr./Mrs.** *[interviewee's name]*, **my colleague Mr./Mrs.** *[interviewer's name]* **has arranged with you that we can now carry out an interview in the context of our international study of high tech firms.** **Let us best start immediately!**		
	Start Interview	☐	
2	**May I first ask you what's your position in the company?** *Int.: Don't read!*		
	Owner/proprietor	☐	
	Chairman	☐	
	Managing director/Chief-Executive-Officer (CEO)	☐	
	Other director	☐	
	(Senior) Manager	☐	
	Other	☐ OPEN	
	refuse	☐	
	Int.: If "other", please note down the position of the interviewee! [＿＿＿＿＿＿＿＿＿＿＿＿＿＿]		

		Background Details		
5	**What year was your company started?**			
	don't know	☐		
	refuse	☐		
	Help for the interviewer: *In case of any doubt, the year of formation is determined by the date of legal incorporation.*			
10	**How many persons are employed by your company today including the entrepreneurs? Please state the number in full-time equivalents.**			
	don't know	☐		
	refuse	☐		
	Help for the interviewer: *A full-time-equivalent is the conversion of the number of part-time employees to an equivalent number of full-time employees. In case of any difficulties with the conversion, 1 part-time employee counts for 1/2 full-time employee.*			
11	**How many persons were employed by your company at the end of the year *2002* including the entrepreneurs? Please state the number in full-time equivalents.**			
	don't know	☐		
	refuse	☐		
	Help for the interviewer: *A full-time-equivalent is the conversion of the number of part-time employees to an equivalent number of full-time employees. In case of any difficulties with the conversion, 1 part-time employee counts for 1/2 full-time employee.*			
12	**How many persons were employed by your company at the end of the year *2001* including the entrepreneurs? Please state the number in full-time equivalents.**			
	don't know	☐		
	refuse	☐		
	Help for the interviewer: *A full-time-equivalent is the conversion of the number of part-time employees to an equivalent number of full-time employees. In case of any difficulties with the conversion, 1 part-time employee counts for 1/2 full-time employee.*			
13	**Please estimate, how many employees (including the entrepreneurs) currently working in your company have a university degree. You can either state the absolute number of employees with a university degree in full time equivalents or their percentage of all employees.**			
	# of employees with university degree	**% of employees with university degree**		
	don't know	☐		
	refuse	☐		
	Help for the interviewer: *A full-time-equivalent is the conversion of the number of part-time employees to an equivalent number of full-time employees. In case of any difficulties with the conversion, 1 part-time employee counts for 1/2 full-time employee.*			
7	**Has there been a significant change in ownership since the formation of your firm?**			
	Yes	☐	**8**	
	No	☐		
	don't know	☐	**9A**	
	refuse	☐		
	Help for the interviewer: *"Significant" means a change in ownership of more than 20 % of your firms equity.*			

8	**Which of the following kinds of change in ownership has occurred in your firm since the company was started? Has there occurred ...**	**Yes**	**No**	**don't know**	**refuse**
	A　a merger, i.e. joint ownership with another firm?	☐	☐	☐	☐
	B　a sale of equity to another firm (including Venture Capital firms) or to a private person?	☐	☐	☐	☐
	C　a management buy-out or buy-in?	☐	☐	☐	☐
	Hint for programming: *If all three questions are answered with "No", continue with question 9A.*				

9	**What year did this change of ownership occur? If there has been more than one change since the company was started, please indicate only the year of the *first* change.**		
	don't know	☐	
	refuse	☐	

9A	**Have you acquired either full or partial ownership of another business since the company was started?**		
	Yes ☐		**9B**
	No ☐		
	don't know ☐		**9E**
	refuse ☐		
9B	**What year did you acquire full or partial ownership of another company for the first time?**		
	[____]		
	don't know ☐		
	refuse ☐		
9D	**Were the acquisitions undertaken *primarily* in order to ...** *Int.: Read out the four topics <u>with</u> the related letters.*		
	A ... enhance capabilities for Research and Development, ☐		
	B ... enhance production capabilities, ☐		
	C ... improve sales prospects on the domestic market, or ☐		
	D ... improve sales prospects on foreign markets? ☐		
	None of this ☐		
	don't know ☐		
	refuse ☐		
9E	**Have you entered into a strategic alliance or a joint venture with another company since your company was started?**		
	Yes ☐		**9F**
	No ☐		
	don't know ☐		**13A**
	refuse ☐		
9F	**What year did you enter into a strategic alliance or a joint venture for the first time?**		
	[____]		
	don't know ☐		
	refuse ☐		
9H	**Were the strategic alliances or joint ventures undertaken *primarily* in order to ...** *Int.: Read out the four topics <u>with</u> the related letters.*		
	A ... enhance capabilities for Research and Development, ☐		
	B ... enhance production capabilities, ☐		
	C ... improve sales prospects on the domestic market, or ☐		
	D ... improve sales prospects on foreign markets? ☐		
	None of this ☐		
	don't know ☐		
	refuse ☐		
	Factors Constraining or Promoting Firm Development		
13A	**In the last two years, has your company carried out Research and Development activities on a permanent basis, occasionally, or not at all?**		
	A permanently ☐		
	B occasionally ☐		**13B**
	C no R&D activities ☐		
	don't know ☐		**13D**
	refuse ☐		
13B	**Approximately, how much did you spend on Research and Development in the year 2002 as percentage of total sales in that year?**		
	[____] **percent of total turnover**		
	don't know ☐		
	refuse ☐		
13C	**How many employees (including the entrepreneurs) currently work for at least 50 percent of their time on research and the development for existing and new products or services? You can either state the absolute number of R&D employees in full time equivalents or their percentage of all employees.**		
	[____] **absolute number of R&D employees** [____] **percentage of R&D employees**		
	don't know ☐		
	refuse ☐		
	Help for the interviewer: *A full-time-equivalent is the conversion of the number of part-time employees to an equivalent number of full-time employees. In case of any difficulties with the conversion, 1 part-time employee counts for 1/2 full-time employee.*		

13D	The international experience of the members of the senior management team may help a company develop. Before joining your company, did any member of your senior management team			
			Yes	**No**
	A	have work experience abroad?	☐	☐
	B	work previously in the UK for an international company?	☐	☐
	C	received education abroad?	☐	☐
	don't know ☐			
	refuse ☐			

13E	I will now read out to you six external factors that can constrain the development of a business. Please indicate on a 5-point scale ranging from 1 "no constraint" up to 5 "very important constraint" the extent the named factor has constrained the development of your company in the last two years.				
		no constraint	**very important constraint**	**don't know**	**refuse**
	A	Availability of finance	☐—☐—☐—☐—☐	☐	☐
	B	Availability of skilled employees	☐—☐—☐—☐—☐	☐	☐
	C	Availability of experienced managem.	☐—☐—☐—☐—☐	☐	☐
	D	Access to sales channels	☐—☐—☐—☐—☐	☐	☐
	E	Access to market information	☐—☐—☐—☐—☐	☐	☐
	F	Red tape or official regulations	☐—☐—☐—☐—☐	☐	☐

13F	The development of a company may also be constrained by a shortage of skills. Please indicate on a 5-point scale ranging from 1 "no shortage" up to 5 "very serious shortage" whether you have experienced in the last two years a shortage of skills within your company in the following areas.				
		no shortage	**serious shortages**	**don't know**	**refuse**
	A	Marketing	☐—☐—☐—☐—☐	☐	☐
	B	Sales and distribution	☐—☐—☐—☐—☐	☐	☐
	C	Financial management	☐—☐—☐—☐—☐	☐	☐
	D	General management	☐—☐—☐—☐—☐	☐	☐
	E	Production, Manufacturing and Logistics	☐—☐—☐—☐—☐	☐	☐
	F	Research and Development	☐—☐—☐—☐—☐	☐	☐

13I	On a 5-point scale ranging from 1 "unimportant" up to 5 "very important", how important to the success of your business is external business advice to your senior management team?	
	unimportant **very important**	
	☐—☐—☐—☐—☐	
	don't know ☐	
	refuse ☐	

13J	Is your bank an important source of advice, market information, or non-financial support?		
	Yes ☐		**13K**
	No ☐		
	don't know ☐		**16**
	refuse ☐		

13K	On a 5-point scale ranging from 1 "unimportant" up to 5 "very important", please rate the importance of the advice your bank offers to you in the following areas.				
		unimportant	**very important**	**don't know**	**refuse**
	A	Financial management	☐—☐—☐—☐—☐	☐	☐
	B	Protection of intellectual property	☐—☐—☐—☐—☐	☐	☐
	C	Marketing and sales	☐—☐—☐—☐—☐	☐	☐
	D	Business strategy	☐—☐—☐—☐—☐	☐	☐

Product Characteristics

16	What was your best selling product or service in the year 2002?		
	Int.: Note down carefully:		
	[_____]		**17**
	don't know ☐		**25**
	refuse ☐		
	Help for the interviewer:		
	"Product or service" is defined as a series of closely related products or services (including various upgrades) whose core elements and technologies are identical.		

17	**Please indicate the share of total turnover of your company that was generated by the best selling product or service in 2002.**	
	[_____] **percent of total turnover**	
	don't know ☐	
	refuse ☐	
18	**Please indicate the year in which this product or service was first sold by your company.**	
	[_____]	
	don't know ☐	
	refuse ☐	
19	**Please refer all answers in *this* section only to your best selling product or service!**	
20	**Which of the following four statements best describes the typical use of your best selling product or service by a typical customer?**	
	Int.: Read out the four descriptions with the related letters.	
	A **A company uses your product as a capital or investment good.** ☐	
	B **A company uses your product as a component to be incorporated in another product.** ☐	
	C **Your service is a business service used by another company.** ☐	
	D **Your product or service is sold directly to consumers.** ☐	
	None of this ☐	
	don't know ☐	
	refuse ☐	
21	**How would you describe the innovativeness of your product or service? I will read out to you four different descriptions of the technology possibly incorporated in your product or service. Please state, which description best applies to your product or service.**	
	Int.: Read out the four descriptions <u>with</u> the related letters.	
	A **Your product or service incorporates "tried and tested" combinations of existing technology.** ☐	
	B **Your product or service incorporates new combinations of existing technology.** ☐	
	C **Your product or service incorporates novel technology that has been developed elsewhere.** ☐	
	D **Your product or service incorporates novel technology that has been developed specifically for this product or service by your company.** ☐	
	None of this ☐	
	don't know ☐	
	refuse ☐	
22	**If we look at the core technologies embodied in your product or service, have there been any *disruptive* changes in these technologies over the last two years?**	
	A *disruptive* change means that you have had to invest in significant new and different technologies or technological skills that your firm did not previously possess in order to produce your product or service competitively.	
	Yes ☐	
	No ☐	
	don't know ☐	
	refuse ☐	
23	**Please indicate the estimated time in months for a competitor to launch either a similar product or service to yours with superior performance, or a product or service with similar performance at a lower price.**	
	[_____] **months**	
	don't know ☐	
	refuse ☐	
24	**Some products or services require a number of support activities for their effective sale or use. Please indicate on a scale from 1 "unimportant" to 5 "very important" the extent to which the sale and the use of your product or service require the following support activities.**	

		unimportant very important	don't know	refuse
A	**Technical consultation prior to sales**	☐—☐—☐—☐—☐	☐	☐
B	**Individual client customisation**	☐—☐—☐—☐—☐	☐	☐
C	**Specific configuration or system requirements**	☐—☐—☐—☐—☐	☐	☐
D	**Complex or time-consuming installation**	☐—☐—☐—☐—☐	☐	☐
E	**Regular maintenance and upgrades**	☐—☐—☐—☐—☐	☐	☐
F	**Specialised training requirement for front-line and sales personnel**	☐—☐—☐—☐—☐	☐	☐

		International Activities					
25		Can I now please ask you some questions on your international business activities. Please note that the following questions now refer to the *full range* of products and services of your company.					
		Do you currently have any foreign sales?					
		Yes	☐				26
		No	☐				
		don't know	☐				27
		refuse	☐				
26		**Please indicate the year when your company first had foreign sales.**					
		don't know	☐				30
		refuse	☐				
27		**Have you ever had foreign sales in the past?**					
		Yes	☐				28
		No	☐				
		don't know	☐				46A
		refuse	☐				
28		**Please indicate the year when your company last had foreign sales.**					
		don't know	☐				29
		refuse	☐				
29		**Please indicate the year when your company first had foreign sales.**					
		don't know	☐				46A
		refuse	☐				
30		**Please indicate the total number of foreign countries to which you currently sell.**					
		don't know	☐				
		refuse	☐				

31	How are your total sales broken down by region? I will list a number of regions. Please tell me, whether you have foreign sales in this region and, if this is the case, please indicate the percentage of total sales your company generated in this region in the year 2002. If you don't know the numbers exactly, a rough estimate is also sufficient.				
		Yes	**No**	**percent**	**don't know**
A	**Domestic (UK-)sales including Northern Ireland**	☐	☐		☐
B	**Other states of the European Union + Norway, Iceland, Switzerland**	☐	☐		☐
C	**Other European states including Russia**	☐	☐		☐
D	**North America (USA, Canada, Mexico)**	☐	☐		☐
E	**Asia including the Middle East***	☐	☐		☐
F	**Australia & New Zealand**	☐	☐		☐
G	**Other regions**	☐	☐		☐
don't know					☐
refuse					☐

Hint for the interviewer:
* Asia includes the Middle East (e.g. Israel) as well as the Far East (e.g. China, Japan, Indonesia).

32		**In your view, will the share of foreign sales in the total sales of your company increase, decrease or remain constant over the next two years?**	
	A	**increase**	☐
	B	**remain constant**	☐
	C	**decrease**	☐
	don't know		☐
	refuse		☐

Questions 33-38 and questions 39A, 40A, and 41A were only asked to whose firms that had international sales in 1997 and that indicated their most important foreign markets in 1997.

33	I would like to ask you about the sales channels you use to reach your foreign customers. In our earlier survey in 1997, we asked about the three most important foreign markets for your company. I will now refer to the specific markets your company then identified.			
	Do you still have foreign sales in *[state country 1]* **?**			
	Yes	☐		**34**
	No	☐		
	don't know	☐		**35**
	refuse	☐		
34	**I will read out six different ways of selling overseas. Please indicate the dominant sales channel you currently use in** *[state country 1]*.			
	Int.: First read out all six possible answers <u>with</u> the related letters.			
	A **Direct exporting**		☐	
	B **Foreign agent who sells on an ad hoc commission basis**		☐	
	C **Foreign distributor who sells on a regular basis**		☐	
	D **Jointly owned foreign sales subsidiary**		☐	
	E **Wholly owned foreign sales subsidiary**		☐	
	F **Licensing**		☐	
	don't know		☐	
	refuse		☐	
35	**Do you still have foreign sales in** *[state country 2]* **?**			
	Yes	☐		**36**
	No	☐		
	don't know	☐		**37**
	refuse	☐		
	Int.: Skip all questions related to the 1997 survey, if country 2 wasn't filled in last time.			**39**
36	**Please indicate the dominant sales mode you currently use to sell to** *[state country 2]*.			
	Int.: Repeat the entry modes if necessary.			
	A **Direct exporting**		☐	
	B **Foreign agent who sells on an ad hoc commission basis**		☐	
	C **Foreign distributor who sells on a regular basis**		☐	
	D **Jointly owned foreign sales subsidiary**		☐	
	E **Wholly owned foreign sales subsidiary**		☐	
	F **Licensing**		☐	
	don't know		☐	
	refuse		☐	
37	**Do you still have foreign sales in** *[state country 3]* **?**			
	Yes	☐		**38**
	No	☐		
	don't know	☐		**39**
	refuse	☐		
	Int.: Skip all questions related to the 1997 survey, if country 3 wasn't filled in last time.			**39**
38	**Please indicate the dominant sales mode you currently use to sell to** *[state country 3]*.			
	Int.: Repeat the entry modes if necessary.			
	A **Direct exporting**		☐	
	B **Foreign agent who sells on an ad hoc commission basis**		☐	
	C **Foreign distributor who sells on a regular basis**		☐	
	D **Jointly owned foreign sales subsidiary**		☐	
	E **Wholly owned foreign sales subsidiary**		☐	
	F **Licensing**		☐	
	don't know		☐	
	refuse		☐	
39	**What are** *today* **your three most important foreign markets in terms of sales? When answering this question, please consider also the country/countries we talked about in the last questions.**			
	Int.: Write down the named countries.			
	Country A Country B Country C			**39A**
	don't know	☐		
	refuse	☐		**43**

39A	*Internal question for the interviewer:*		
	Is [show country A] one of the countries 1, 2, or 3 as stated in the 1997 survey?		
	Yes ☐		**40A**
	No ☐		**40**
	Hint for programming:		
	*This question will only be asked, if a country A is stated. Otherwise continue with question **43**.*		
40	**Please indicate the dominant sales mode you currently use to sell to [*show country A*].**		
	Int.: Repeat the entry modes if necessary.		
	A **Direct exporting**	☐	
	B **Foreign agent who sells on an ad hoc commission basis**	☐	
	C **Foreign distributor who sells on a regular basis**	☐	
	D **Jointly owned foreign sales subsidiary**	☐	
	E **Wholly owned foreign sales subsidiary**	☐	
	F **Licensing**	☐	
	don't know	☐	
	refuse	☐	
40A	*Internal question for the interviewer:*		
	Is [show country B] one of the countries 1, 2, or 3 as stated in the 1997 survey?		
	Yes ☐		**41A**
	No ☐		**41**
	Hint for programming:		
	*This question will only be asked, if a country B is stated. Otherwise continue with question **43**.*		
41	**Please indicate the dominant sales mode you currently use to sell to [*show country B*].**		
	Int.: Repeat the entry modes if necessary.		
	A **Direct exporting**	☐	
	B **Foreign agent who sells on an ad hoc commission basis**	☐	
	C **Foreign distributor who sells on a regular basis**	☐	
	D **Jointly owned foreign sales subsidiary**	☐	
	E **Wholly owned foreign sales subsidiary**	☐	
	F **Licensing**	☐	
	don't know	☐	
	refuse	☐	
41A	*Interne Frage für den Interviewer:*		
	Is [show country C] one of the countries 1, 2, or 3 as stated in the 1997 survey?		
	Yes ☐		**43**
	No ☐		**42**
	Hint for programming:		
	*This question will only be asked, if a country C is stated. Otherwise continue with question **43**.*		
42	**Please indicate the dominant sales mode you currently use to sell to [show country C].**		
	Int.: Repeat the entry modes if necessary.		
	A **Direct exporting**	☐	
	B **Foreign agent who sells on an ad hoc commission basis**	☐	
	C **Foreign distributor who sells on a regular basis**	☐	
	D **Jointly owned foreign sales subsidiary**	☐	
	E **Wholly owned foreign sales subsidiary**	☐	
	F **Licensing**	☐	
	don't know	☐	
	refuse	☐	
43	**Do you produce your company's products or services only in the UK, only overseas, or both in the UK and overseas?**		
	A **only domestic production**	☐	**46A**
	B **only overseas production**	☐	**44**
	C **both foreign and overseas production**	☐	
	don't know	☐	**46A**
	refuse	☐	
44	**Please tell me in which countries other than the UK you produce goods or services.**		
	Int.: Write down the named countries.		
	don't know	☐	
	refuse	☐	

44A	Please state the current percentage of total employees that are working permanently outside the UK.		
	percent		
	don't know ☐		
	refuse ☐		

Sources of Finance

46A	Finally, I would like to ask you for some financial statistics on your company. May I repeat that information you give us is absolutely confidential.		
	Please indicate the total sales turnover of your company for the year 2002.		
	sales in £ 1,000s		
	don't know ☐		
	refuse ☐		
46B	Please indicate the gross margin as a percentage of total sales for your company for the year 2002.		
	percent of total sales		
	don't know ☐		
	refuse ☐		
46C	How do you think the total sales of your company will change in the next two years?		
	Will they ...		
	A **increase, ...** ☐		
	B **remain constant, or ...** ☐		
	C **decrease?** ☐		
	don't know ☐		
	refuse ☐		
46D	Please indicate the total gross investment in physical capital of your company for the year 2002.		
	investment in £ 1,000s		
	don't know ☐		
	refuse ☐		
46E	Has your business received public grants or awards individually greater than £ 20,000 since January 1998?		
	Yes ☐		**46F**
	No ☐		
	don't know ☐		**47**
	refuse ☐		

46F	Please indicate whether you received public grants or awards individually greater than £ 20,000 form the following sources since January 1998 and, if relevant, state their individual values.		

		Yes	No	amount 1	amount 2 in £ 1,000s	amount 3
A	Regional Agencies	☐	☐			
B	National Agencies	☐	☐			
C	European Agencies	☐	☐			
D	Public Banks	☐	☐			
don't know		☐				
refuse		☐				

47	I will now read out to you several sources of equity. Please indicate whether or not you received *additional* equity from these sources in the last two years.				

		Yes	No	don't know	refuse
A	Equity from owners	☐	☐	☐	☐
B	Equity from employees	☐	☐	☐	☐
C	Equity from Business Angels or private individuals	☐	☐	☐	☐
D	Equity from Venture Capitalists	☐	☐	☐	☐
E	Equity from other sources	☐	☐	☐	☐

48	Now, I will read out to you several sources of *debt* finance. As in the last question, please indicate whether you received additional debt finance from these sources in the last two years.					
		Yes	**No**	don't know	refuse	
	A	Loans from owners	☐	☐	☐	☐
	B	Loans form a Business Angel or a private person	☐	☐	☐	☐
	C	Loans from a Venture Capitalist	☐	☐	☐	☐
	D	Short term loans from banks including bank overdraft	☐	☐	☐	☐
	E	Long term loans from banks	☐	☐	☐	☐
	F	Other sources of debt finance	☐	☐	☐	☐

Help for the interviewer (topic D+E):
Short term loans are loans with a maturity of less than 3 years. Long term loans are loans with a maturity of 3 years or longer.

48A	Regarding the sources of finance you just have noted, please indicate the amount of additional finance you raised from these sources in the last two years. I will start with the sources of equity.				
			amount in £ 1,000s	don't know	refuse
	A	Equity from owners	☐	☐	☐
	B	Equity from employees	☐	☐	☐
	C	Equity from Business Angels or private individ.	☐	☐	☐
	D	Equity from Venture Capitalists	☐	☐	☐
	E	Equity from other sources	☐	☐	☐

Hint for programming:
The individual topics A-E will only be asked, if the related topic in question 47 is answered with "Yes".

48B	Let me now return to the sources of debt finance. As in the last question, please indicate the amount of additional debt finance you raised from these sources in the last two years.				
			amount in £ 1,000s	don't know	refuse
	A	Loans from owners	☐	☐	☐
	B	Loans form a Business Angel or a private person	☐	☐	☐
	C	Loans from a Venture Capitalist	☐	☐	☐
	D	Short term loans from banks incl. bank overdraft	☐	☐	☐
	E	Long term loans from banks	☐	☐	☐
	F	Other sources of debt finance	☐	☐	☐

Help for the interviewer (topic D+E):
Short term loans are loans with a maturity of less than 3 years. Long term loans are loans with a maturity of 3 years or longer.

Hint for programming:
The individual topics A-F will only be asked, if the related topic in question 48 is answered with "Yes".

Thank you very much for your help! Can I repeat that this information will remain totally confidential.

Later this year, we will be doing a number of case studies on individual firms. Would you be prepared to participate in a case study? This will require approximately one and a half hour of discussion with you and key managers.

Yes ☐

No ☐

don't know ☐

Thank you again for your help!

Goodbye.

Nr.	Einleitung		weiter mit Nr.
1	**Guten Tag. Mein Name ist ...** **Ich rufe an vom Zentrum für Europäische Wirtschaftsforschung in Mannheim. Wir haben kürzlich an Ihr Unternehmen geschrieben bezüglich einer langfristigen internationalen Untersuchung unter technologieorientierten Unternehmen. Bei unserer ersten Befragung im Jahr 1998 hat Ihr Unternehmen sich bereit erklärt, an dieser langfristigen Studie teilzunehmen. Kann ich bitte mit dem Inhaber Ihres Unternehmens sprechen oder mit einem Mitglied Ihrer Geschäftsführung.** *Int.: Oben stehende Einleitung wiederholen bis die gewünschte Stelle am Apparat.* **Beginn Interview**	☐	**1A**
	Verweigert	☐	
	Falsche Verbindung	☐	
	kein Anschluss	☐	**Firma sperren**
	Unternehmen bereits befragt	☐	
	Unternehmen gehört nicht zur Zielgruppe.	☐	
	Unternehmen tot/in Auflösung	☐	
	Kein Interview möglich aus anderen Gründen	☐	
	Anrufbeantworter/keine Verbindung/besetzt	☐	**neuer Kontaktvers.**
	OPTIONAL: *Int.: Bitte das Datum und die Zeit notieren, welche der Interviewpartner für das Interview vorschlägt.* **Datum** [ ] **Zeit** [ ] OPTIONAL: *Schriftlicher Fragebogen wird (per Fax) zugeschickt:* ☐		
1A	*Int.: Bitte den Namen des Interviewpartners notieren.*		
1B	**Guten Tag Herr/Frau** *[Name des Gesprächspartners]*. **Das Zentrum für Europäische Wirtschaftsforschung führt zurzeit zusammen mit der University of Exeter eine langfristige internationale Untersuchung zur Entwicklung technologieorientierter Unternehmen in Deutschland und Großbritannien durch. Diese Untersuchung ist die Fortführung einer Studie aus dem Jahr 1998 die damals großes Interesse in der Wissenschaft und der Wirtschaftspolitik gefunden hat und an der Ihr Unternehmen ebenfalls teilgenommen hat.** **Ziel unserer Studie ist es, die wandelnden Bedingungen, unter denen technologieorientierte Unternehmen arbeiten, bestimmen zu können. Aus diesem Grund sind wir besonders daran interessiert, mit Ihnen ein Interview zu führen, da Sie bereits an unserer ersten Umfrage 1998 teilgenommen haben.** **Die Beantwortung unserer Fragen erfordert etwa 20 Minuten. Darf ich betonen, dass alle Informationen absolut vertraulich behandelt werden. Haben Sie jetzt Zeit für ein Interview oder zu welchem anderen Termin darf ich Sie noch einmal anrufen?** **OPTIONAL: Welche andere Person in Ihrem Unternehmen kann mir Fragen zum Produktmanagement und zur Finanzierungsstrategie beantworten?** **Fortsetzung Interview**	☐	**2**
	Verweigert	☐	
	Falsche Verbindung	☐	
	kein Anschluss	☐	**Firma sperren**
	Unternehmen bereits befragt	☐	
	Unternehmen gehört nicht zur Zielgruppe.	☐	
	Kein Interview möglich aus anderen Gründen	☐	
	OPTIONAL: *Int.: Bitte das Datum und die Zeit notieren, welche der Interviewpartner für das Interview vorschlägt.* **Datum** [ ] **Zeit** [ ] OPTIONAL: *Schriftlicher Fragebogen wird (per Fax) zugeschickt:* ☐		
1C	*Hinweis für die Programmierung: Startfenster für RESTART* **Guten Tag Herr/Frau** *[Name des Gesprächspartners]*, **mein Kollege Herr** *[Name des Interviewers]* **hat mit Ihnen vereinbart, dass wir jetzt ein Interview im Rahmen unserer internationalen Studie zur Entwicklung technologieorientierter Unternehmen führen können.** **Lassen Sie uns am besten gleich beginnen!** **Start Interview**	☐	

2	**Darf ich Sie zunächst fragen, welche Position Sie im Unternehmen haben?**		
	Int.: Nicht vorlesen!		
	Inhaber/Gesellschafter	☐	
	Geschäftsführer/Prokurist	☐	
	Abteilungsleiter	☐	
	Manager	☐	
	andere Position	☐	OPEN
	verweigert	☐	
	Int.: Falls „andere Position", bitte die Position des Interviewpartners genau notieren.		

	Allgemeine Fragen zum Unternehmen		
5	**Bitte nennen Sie mir das Gründungsjahr Ihres Unternehmens.**		
	weiß nicht	☐	
	verweigert	☐	
	Hilfe für den Interviewer:		
	Im Zweifelsfalle wird das Gründungsjahr bestimmt durch das Datum der Gewerbeanmeldung.		
10	**Wie viele Mitarbeiter arbeiten zurzeit in Ihrem Unternehmen, einschließlich der Unternehmer? Bitte geben Sie die Zahl in Vollzeitstellen an.**		
	weiß nicht	☐	
	verweigert	☐	
	Hilfe für den Interviewer:		
	Eine Vollzeitstelle ist die Umrechnung der Zahl der Teilzeitbeschäftigten in eine äquivalente Zahl Vollzeitbeschäftigter. Bei Schwierigkeiten mit der Umrechnung zählt 1 Teilzeitbeschäftigter als 1/2 Vollzeitbeschäftigter.		
11	**Wie viele Mitarbeiter haben in Ihrem Unternehmen Ende des Jahres *2002* gearbeitet, einschließlich der Unternehmer? Bitte geben Sie die Zahl in Vollzeitstellen an.**		
	weiß nicht	☐	
	verweigert	☐	
	Hilfe für den Interviewer:		
	Eine Vollzeitstelle ist die Umrechnung der Zahl der Teilzeitbeschäftigten in eine äquivalente Zahl Vollzeitbeschäftigter. Bei Schwierigkeiten mit der Umrechnung zählt 1 Teilzeitbeschäftigter als 1/2 Vollzeitbeschäftigter.		
12	**Wie viele Mitarbeiter haben in Ihrem Unternehmen Ende des Jahres *2001* gearbeitet, einschließlich der Unternehmer? Bitte geben Sie die Zahl in Vollzeitstellen an.**		
	weiß nicht	☐	
	verweigert	☐	
	Hilfe für den Interviewer:		
	Eine Vollzeitstelle ist die Umrechnung der Zahl der Teilzeitbeschäftigten in eine äquivalente Zahl Vollzeitbeschäftigter. Bei Schwierigkeiten mit der Umrechnung zählt 1 Teilzeitbeschäftigter als 1/2 Vollzeitbeschäftigter.		
13	**Bitte schätzen Sie, wie viele der Mitarbeiter (einschließlich der Unternehmer), die gegenwärtig in Ihrem Unternehmen arbeiten, einen Hochschulabschluss besitzen. Sie können entweder die absolute Zahl der Mitarbeiter mit Hochschulabschluss in Vollzeitstellen nennen oder deren Anteil an allen Mitarbeitern.**		
	# der Mitarbeiter mit Hochschulabschluss **# der Mitarbeiter mit Hochschulabschluss**		
	weiß nicht	☐	
	verweigert	☐	
	Hilfe für den Interviewer:		
	Eine Vollzeitstelle ist die Umrechnung der Zahl der Teilzeitbeschäftigten in eine äquivalente Zahl Vollzeitbeschäftigter. Bei Schwierigkeiten mit der Umrechnung zählt 1 Teilzeitbeschäftigter als 1/2 Vollzeitbeschäftigter.		
7	**Gab es in Ihrem Unternehmen seit dessen Gründung eine wesentliche Änderung in der Eigentümerstruktur?**		
	Ja	☐	**8**
	Nein	☐	
	weiß nicht	☐	**9A**
	verweigert	☐	
	Hilfe für den Interviewer:		
	„Wesentlich" bedeutet eine Besitzveränderung von mehr als 20 % des Eigenkapitals des Unternehmens.		

8	Welche der folgenden Änderungen in der Eigentümerstruktur haben in Ihrem Unternehmen seit dessen Gründung stattgefunden? Gab es ...				
		Ja	**Nein**	weiß nicht	verweigert
A	... eine Fusion mit einem anderen Unternehmen?	☐	☐	☐	☐
B	... den Verkauf von Eigenkapital an ein anderes Unternehmen (einschl. Venture-Capital-Untern.) oder an eine Privatperson?	☐	☐	☐	☐
C	... ein Management buy-out oder buy-in?	☐	☐	☐	☐

Hinweis für die Programmierung:
Wenn alle drei Fragen mit „Nein" beantwortet werden, bitte weiter mit Frage 9A.

9	In welchem Jahr fand diese Änderung in der Eigentümerstruktur statt? Sofern es mehrere Änderungen seit der Unternehmensgründung gegeben hat, nennen Sie mir bitte nur das Jahr der ersten Veränderung.	
	weiß nicht ☐	
	verweigert ☐	

9A	Haben Sie sich entweder zu 100 Prozent oder partiell an einem anderen Unternehmen beteiligt seitdem Ihr Unternehmen gegründet wurde?	
	Ja ☐	**9B**
	Nein ☐	
	weiß nicht ☐	**9E**
	verweigert ☐	

9B	In welchem Jahr haben Sie sich erstmals an einem anderen Unternehmen beteiligt?	
	weiß nicht ☐	
	verweigert ☐	

9D	Haben Sie diese Beteiligungen in erster Linie erworben um ...	
	Int.: Bitte zuerst die vier Punkte mit den dazugehörigen Buchstaben vorlesen.	
A	... die Kapazitäten für Forschung und Entwicklung zu erweitern,	☐
B	... die Produktionskapazitäten zu erweitern,	☐
C	... die Verkaufsaussichten auf dem heimischen Markt zu verbessern oder	☐
D	... die Verkaufsaussichten auf ausländischen Märkten zu verbessern?	☐
	Keine davon	☐
	weiß nicht	☐
	verweigert	☐

9E	Sind Sie in eine strategische Allianz oder in ein Joint Venture eingetreten seitdem Ihr Unternehmen gegründet wurde?	
	Ja ☐	**9F**
	Nein ☐	
	weiß nicht ☐	**13A**
	verweigert ☐	

9F	In welchem Jahr sind Sie *erstmals* in eine strategische Allianz oder in ein Joint Venture eingetreten?	
	weiß nicht ☐	
	verweigert ☐	

9H	Wurden die strategischen Allianzen oder Joint Ventures von Ihnen in erster Linie geschlossen um ...	
	Int.: Bitte zuerst die vier Punkte mit den dazugehörigen Buchstaben vorlesen.	
A	... die Kapazitäten für Forschung und Entwicklung zu erweitern,	☐
B	... die Produktionskapazitäten zu erweitern,	☐
C	... die Verkaufsaussichten auf dem heimischen Markt zu verbessern oder	☐
D	... die Verkaufsaussichten auf ausländischen Märkten zu verbessern?	☐
	Keine davon	☐
	weiß nicht	☐
	verweigert	☐

Hemmende und unterstützende Faktoren der Unternehmensentwicklung

13A	Hat Ihr Unternehmen in den letzten zwei Jahren Forschungs- und Entwicklungsaktivitäten kontinuierlich, gelegentlich oder überhaupt nicht durchgeführt?	
A	kontinuierlich ☐	
B	gelegentlich ☐	**13B**
C	keine FuE-Aktivitäten ☐	
	weiß nicht ☐	**13D**
	verweigert ☐	

13B	Wie viel hat Ihr Unternehmen im Jahr 2002 ungefähr für Forschung und Entwicklung ausgegeben in Prozent des Umsatzes?	
	Prozent am Umsatz	
	weiß nicht ☐	
	verweigert ☐	

13C	Wie viele Mitarbeiter sind derzeit in Ihrem Unternehmen mindestens 50 Prozent ihrer Arbeitszeit mit Forschung und der Entwicklung existierender beziehungsweise neuer Produkte oder Dienstleistungen beschäftigt? Sie können entweder die absolute Zahl der FuE-Mitarbeiter in Vollzeitstellen nennen oder deren Anteil an allen Mitarbeitern.	
	# der FuE-Mitarbeiter % der FuE-Mitarbeiter	
	weiß nicht ☐	
	verweigert ☐	
	Hilfe für den Interviewer:	
	Eine Vollzeitstelle ist die Umrechnung der Zahl der Teilzeitbeschäftigten in eine äquivalente Zahl Vollzeitbeschäftigter. Bei Schwierigkeiten mit der Umrechnung zählt 1 Teilzeitbeschäftigter als 1/2 Vollzeitbeschäftigter.	

13D	Die internationale Erfahrung von Mitgliedern der Geschäftsführung kann für die Entwicklung eines Unternehmens förderlich sein. Verfügten Mitglieder Ihrer Geschäftsführung, bevor sie in Ihr Unternehmen eintraten, ...	

		Ja	Nein
A	... über Arbeitserfahrung im Ausland?	☐	☐
B	... über Arbeitserfahrung in einem international tätigen Unternehmen im Inland?	☐	☐
C	... über eine Ausbildung im Ausland?	☐	☐
weiß nicht ☐			
verweigert ☐			

13E	Ich nenne Ihnen nun sechs externe Faktoren, die die Entwicklung eines Unternehmens behindern können. Bitte beurteilen Sie auf einer 5-Punkte-Skala von 1 „kein Hemmnis" bis 5 „sehr bedeutendes Hemmnis", inwieweit der genannte Faktor die Entwicklung Ihres Unternehmens in den letzten zwei Jahren gehemmt hat.	

		kein Hemmnis — sehr bedeutendes Hemmnis	weiß nicht	verweigert
A	Verfügbarkeit von Finanzmitteln	☐—☐—☐—☐—☐	☐	☐
B	Verfügbarkeit von Fachpersonal	☐—☐—☐—☐—☐	☐	☐
C	Verfügbarkeit von erfahrenen Managern	☐—☐—☐—☐—☐	☐	☐
D	Zugang zu Verkaufskanälen	☐—☐—☐—☐—☐	☐	☐
E	Zugang zu Marktinformationen	☐—☐—☐—☐—☐	☐	☐
F	Bürokratische und rechtliche Regelungen	☐—☐—☐—☐—☐	☐	☐

13F	Die Entwicklung eines Unternehmens kann des Weiteren gehemmt werden durch einen Mangel an Know-how. Bitte beurteilen Sie auf einer 5-Punkte-Skala von 1 „kein Mangel" bis 5 „sehr bedeutender Mangel", inwieweit in den letzten zwei Jahren ein Mangel an Know-how innerhalb Ihres Unternehmens in den folgenden Feldern aufgetreten ist.	

		kein Mangel — sehr bedeutender Mangel	weiß nicht	verweigert
A	Marketing	☐—☐—☐—☐—☐	☐	☐
B	Verkauf und Vertrieb	☐—☐—☐—☐—☐	☐	☐
C	Finanzmanagement	☐—☐—☐—☐—☐	☐	☐
D	Organisation	☐—☐—☐—☐—☐	☐	☐
E	Produktion und Logistik	☐—☐—☐—☐—☐	☐	☐
F	Forschung und Entwicklung	☐—☐—☐—☐—☐	☐	☐

13I	Bitte beurteilen Sie auf einer 5-Punkte-Skala von 1 „unwichtig" bis 5 „sehr wichtig", wie wichtig für den Erfolg Ihres Unternehmens die externe Beratung Ihrer Geschäftsführung ist.	
	unwichtig — sehr wichtig	
	☐—☐—☐—☐—☐	
	weiß nicht ☐	
	verweigert ☐	

13J	Ist Ihre Hausbank eine wichtige Quelle der Beratung, der Marktinformation oder von nicht-finanzieller Unterstützung?		
	Ja	☐	**13K**
	Nein	☐	
	weiß nicht	☐	**16**
	verweigert	☐	

13K	Wie wichtig ist für Sie die Beratung durch Ihre Hausbank in den folgenden Feldern, gemessen auf einer Skala von 1 „unwichtig" bis 5 „sehr wichtig"?			

		unwichtig sehr wichtig	weiß nicht	verweigert
A	Finanzmanagement	□—□—□—□—□	□	□
B	Schutz von geistigem Eigentum	□—□—□—□—□	□	□
C	Marketing und Verkauf	□—□—□—□—□	□	□
D	Geschäftsstrategie	□—□—□—□—□	□	□

Produkteigenschaften

16	Was war Ihr umsatzstärkstes Produkt oder Dienstleistung im Jahr 2002?		
	Int.: Bitte genau notieren.		
			17
	weiß nicht	□	
	verweigert	□	**25**
	Hilfe für den Interviewer:		
	„Produkt oder Dienstleistung" ist definiert als eine Serie eng verwandter Produkte oder Dienstleistungen, deren Kernelemente oder -technologien identisch sind. Z.B. gehören alle Modelle des VW Polo einer Produktlinie an, der VW Passat ist eine andere Produktlinie.		

17	Wie hoch war der Anteil Ihres umsatzstärksten Produkts oder Dienstleistung am gesamten Umsatz im Jahr 2002?	
	Prozent am Umsatz	
	weiß nicht	□
	verweigert	□

18	In welchem Jahr wurde dieses Produkt oder diese Dienstleistung von Ihrem Unternehmen am Markt eingeführt?	
	weiß nicht	□
	verweigert	□

19	Bitte beziehen Sie alle Antworten in diesem Abschnitt auf Ihr umsatzstärkstes Produkt oder Dienstleistung!

20	Welche der vier folgenden Beschreibungen charakterisiert am besten die typische Nutzung Ihres Produkts oder Ihrer Dienstleistung durch einen typischen Kunden?	
	Int.: Bitte zuerst die vier Beschreibungen mit den dazugehörigen Buchstaben vorlesen.	
A	Ein Unternehmen nutzt Ihr Produkt als ein Investitionsgut.	□
B	Ein Unternehmen nutzt Ihr Produkt als ein Zwischenprodukt, das in ein anderes Produkt eingeht.	□
C	Ihre Dienstleistung wird von einem anderen Unternehmen als unternehmensnahe Dienstleistung nachgefragt.	□
D	Produkt oder Ihre Dienstleistung wird direkt vom Endverbraucher genutzt.	□
	Keine davon	□
	weiß nicht	□
	verweigert	□

21	Wie würden Sie den Innovationsgrad Ihres Produkts oder Ihrer Dienstleistung beschreiben? Ich nenne Ihnen vier mögliche Beschreibungen von Techniken, aus denen Ihr Produkt oder Ihre Dienstleistung möglicherweise besteht. Bitte geben Sie an, welche der Beschreibungen am besten auf Ihr Produkt oder Ihre Dienstleistung zutrifft.	
	Int.: Bitte zuerst die vier Beschreibungen mit den dazugehörigen Buchstaben vorlesen.	
A	Ihr Produkt oder Ihre Dienstleistung besteht aus erprobten und allgemein gebräuchlichen Kombination vorhandener Techniken.	□
B	Ihr Produkt oder Ihre Dienstleistung besteht aus einer neuen Kombination vorhandener Techniken.	□
C	Ihr Produkt oder Ihre Dienstleistung besteht aus neuen Techniken, die von Dritten entwickelt wurden.	□
D	Ihr Produkt oder Ihre Dienstleistung besteht aus neuen Techniken, die von Ihnen speziell für dieses Produkt oder diese Dienstleistung entwickelt wurden.	□
	Keine davon	□
	weiß nicht	□
	verweigert	□

22	Wenn Sie die Basistechnologien betrachten, mit denen Ihr Produkt oder Ihre Dienstleistung hergestellt wird, gab es bei diesen Technologien *einschneidende* Veränderungen in den letzten zwei Jahren?	
	Einschneidende Veränderungen bedeuten, dass Ihr Unternehmen in neue oder wesentlich veränderte Technologien oder in technologisches Know-how investieren musste, um mit Ihrem Produkt oder Ihrer Dienstleistung wettbewerbsfähig zu bleiben.	
	Ja	□
	Nein	□
	weiß nicht	□
	verweigert	□

23	Bitte schätzen Sie den Zeitraum in Monaten, den ein Wettbewerber benötigt, um ein vergleichbares Produkt oder eine vergleichbare Dienstleistung mit höherer Leistungsfähigkeit oder, bei gleicher Leistungsfähigkeit, zu geringeren Kosten anzubieten.		

Monate

weiß nicht ☐
verweigert ☐

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24 — Einige Produkte oder Dienstleistungen erfordern eine Reihe unterstützender Maßnahmen bei ihrem Verkauf und ihrer Nutzung. Bitte beurteilen Sie auf einer Skala von 1 „unwichtig" bis 5 „sehr wichtig", wie wichtig die nachfolgend genannten Unterstützungsmaßnahmen für den Verkauf und die Nutzung Ihres Produkts oder Ihrer Dienstleistung sind.

		unwichtig	sehr wichtig	weiß nicht	verweigert
A	Spezifische Verkaufsberatung	☐—☐—☐—☐—☐		☐	☐
B	Kundenspezifische Produktanpassung	☐—☐—☐—☐—☐		☐	☐
C	Spezifische Konfiguration und Systemvoraussetzungen	☐—☐—☐—☐—☐		☐	☐
D	Komplizierte und zeitaufwändige Installation	☐—☐—☐—☐—☐		☐	☐
E	Regelmäßige Wartung und Updates	☐—☐—☐—☐—☐		☐	☐
F	Spezifische Schulung des Vertriebs- und Verkaufspersonals	☐—☐—☐—☐—☐		☐	☐

Internationale Geschäftsaktivitäten

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25 — Lassen Sie mich nun einige Fragen zu Ihren internationalen Geschäftsaktivitäten stellen. Bitte beachten Sie, dass alle folgenden Fragen sich jetzt wieder auf die *komplette* Palette der Produkte und Dienstleistungen Ihres Unternehmens beziehen.

Erzielt Ihr Unternehmen zurzeit Umsätze im Ausland?

Ja	☐	**26**
Nein	☐	
weiß nicht	☐	**27**
verweigert	☐	

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26 — Bitte nennen Sie das Jahr, in dem Ihr Unternehmen erstmals Umsätze im Ausland erzielte.

weiß nicht	☐	**30**
verweigert	☐	

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27 — Haben Sie in der Vergangenheit jemals Umsätze im Ausland erzielt?

Ja	☐	**28**
Nein	☐	
weiß nicht	☐	**46A**
verweigert	☐	

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28 — Bitte nennen Sie das Jahr, in dem Ihr Unternehmen zuletzt Umsätze im Ausland erzielte.

weiß nicht	☐	**29**
verweigert	☐	

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29 — Bitte nennen Sie das Jahr, in dem Ihr Unternehmen erstmals Umsätze im Ausland erzielte.

weiß nicht	☐	**46A**
verweigert	☐	

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30 — In wie vielen Ländern, abgesehen vom Inland, sind Sie derzeit tätig?

weiß nicht ☐
verweigert ☐

31	Wie verteilt sich Ihr gesamter Umsatz nach Regionen? Ich nenne Ihnen jetzt eine Liste von Regionen. Bitte sagen Sie mir, ob Sie Umsätze in der betreffenden Region erzielen und wenn ja, wie hoch der Umsatzanteil dieser Region in Prozent ist. Wenn Sie die Zahl nicht genau wissen, so reicht auch ein grobe Schätzung.		

		Ja	Nein	Prozent des Umsatzes	weiß nicht
A	**Deutschland**	☐	☐		☐
B	**andere Länder der Europäischen Union zuzüglich Norwegen, Island und der Schweiz**	☐	☐		☐
C	**andere europäische Länder**	☐	☐		☐
D	**Nordamerika (USA, Kanada, Mexiko)**	☐	☐		☐
E	**Asien ***	☐	☐		☐
F	**Australien und Neuseeland**	☐	☐		☐
G	**andere Regionen**	☐	☐		☐
weiß nicht					☐
verweigert					☐

* Hilfe für den Interviewer:

„Asien" umfasst den Nahen Osten (z.B. Israel) wie auch Indien und Ostasien (z.B. China, Japan, Indonesien).

32	Erwarten Sie, dass der Anteil des im Ausland erzielten Umsatzes am gesamten Umsatz Ihres Unternehmens in den nächsten zwei Jahren steigen, gleich bleiben oder sinken wird?	
	A **steigen**	☐
	B **gleich bleiben**	☐
	C **sinken**	☐
	weiß nicht	☐
	verweigert	☐

	Questions 33-38 and questions 39A, 40A, and 41A were only asked to whose firms that had international sales in 1997 and that indicated their most important foreign markets in 1997.	

33	Ich möchte Ihnen nun einige Fragen zu Ihren Vertriebsformen im Auslandsgeschäft stellen. In unserer früheren Umfrage von 1997 haben wir nach den drei wichtigsten Auslandsmärkten Ihres Unternehmens gefragt. Ich werde mich auf diese drei spezifischen Märkte beziehen, die von Ihrem Unternehmen genannt worden sind.	
	Erzielen Sie immer noch Umsätze in *[nenne Land 1]* ?	
	Ja ☐	**34**
	Nein ☐	
	weiß nicht ☐	**35**
	verweigert ☐	

34	Ich nenne Ihnen nun sechs verschiedene Vertriebsformen im Auslandsgeschäft. Bitte geben Sie an, welche dieser Vertriebsformen Ihr Unternehmen heute in *[nenne Land 1]* in erster Linie nutzt.	
	Int.: Bitte zuerst die sechs Vertriebsformen mit den dazugehörigen Buchstaben vorlesen.	
	A **Direktexport**	☐
	B **Ausländische Handelsvertreter auf Kommissionsbasis**	☐
	C **Ausländische Händler**	☐
	D **Handelsniederlassungen im Ausland mit Beteiligung Dritter**	☐
	E **Eigene Handelsniederlassung im Ausland ohne Beteiligung Dritter**	☐
	F **Lizenzvergabe**	☐
	weiß nicht	☐
	verweigert	☐

35	**Erzielen Sie immer noch Umsätze in *[nenne Land 2]* ?**	
	Ja ☐	**36**
	Nein ☐	
	weiß nicht ☐	**37**
	verweigert ☐	
	Int.: Überspringe diese und alle anderen Fragen, die sich auf die 1997er Umfrage beziehen, wenn kein Land 2 das letzte Mal angegeben wurde.	**39**

36	**Bitte geben Sie an, welche Vertriebsform Ihr Unternehmen heute in *[nenne Land 2]* in erster Linie nutzt.**		
	Int.: Die sechs Vertriebsformen wiederholen, falls erforderlich.		
	A **Direktexport**	☐	
	B **Ausländische Handelsvertreter auf Kommissionsbasis**	☐	
	C **Ausländische Händler**	☐	
	D **Handelsniederlassungen im Ausland mit Beteiligung Dritter**	☐	
	E **Eigene Handelsniederlassung im Ausland ohne Beteiligung Dritter**	☐	
	F **Lizenzvergabe**	☐	
	weiß nicht	☐	
	verweigert	☐	
37	**Erzielen Sie immer noch Umsätze in *[nenne Land 3]* ?**		
	Ja ☐		**38**
	Nein ☐		
	weiß nicht ☐		**39**
	verweigert ☐		
	Int.: Überspringe diese und alle anderen Fragen, die sich auf die 1997er Umfrage beziehen, wenn kein Land 3 das letzte Mal angegeben wurde.		**39**
38	**Bitte geben Sie an, welche Vertriebsform Ihr Unternehmen heute in *[nenne Land 3]* in erster Linie nutzt.**		
	Int.: Die sechs Vertriebsformen wiederholen, falls erforderlich.		
	A **Direktexport**	☐	
	B **Ausländische Handelsvertreter auf Kommissionsbasis**	☐	
	C **Ausländische Händler**	☐	
	D **Handelsniederlassungen im Ausland mit Beteiligung Dritter**	☐	
	E **Eigene Handelsniederlassung im Ausland ohne Beteiligung Dritter**	☐	
	F **Lizenzvergabe**	☐	
	weiß nicht	☐	
	verweigert	☐	
39	**Welches sind *heute* Ihre drei umsatzstärksten Auslandsmärkte? Bitte berücksichtigen Sie bei Ihrer Antwort auch das Land/die Länder, das/die in den vorangegangenen Fragen behandelt wurde(n).**		
	Int.: Bitte die genannten Länder notieren.		
	Land A Land B Land C		
	☐____☐ ☐____☐ ☐____☐		**39A**
	weiß nicht ☐		**43**
	verweigert ☐		
39A	*Interne Frage für den Interviewer:*		
	Ist [zeige Land A] eines der Länder 1, 2 oder 3, die in der 1997er Umfrage genannt wurden?		
	Ja ☐		**40A**
	Nein ☐		**40**
	Hinweis für die Programmierung:		
	Diese Frage wird nur gestellt, wenn ein Land A genannt wurde. Sonst springe auf Frage 43.		
40	**Bitte geben Sie an, welche Vertriebsform Ihr Unternehmen heute in *[zeige Land A]* in erster Linie nutzt.**		
	Int.: Die sechs Vertriebsformen wiederholen, falls erforderlich.		
	A **Direktexport**	☐	
	B **Ausländische Handelsvertreter auf Kommissionsbasis**	☐	
	C **Ausländische Händler**	☐	
	D **Handelsniederlassungen im Ausland mit Beteiligung Dritter**	☐	
	E **Eigene Handelsniederlassung im Ausland ohne Beteiligung Dritter**	☐	
	F **Lizenzvergabe**	☐	
	weiß nicht	☐	
	verweigert	☐	
40A	*Interne Frage für den Interviewer:*		
	Ist [zeige Land B] eines der Länder 1, 2 oder 3, die in der 1997er Umfrage genannt wurden?		
	Ja ☐		**41A**
	Nein ☐		**41**
	Hinweis für die Programmierung:		
	Diese Frage wird nur gestellt, wenn ein Land B genannt wurde. Sonst springe auf Frage 43.		

41	**Bitte geben Sie an, welche Vertriebsform Ihr Unternehmen heute in *[zeige Land B]* in erster Linie nutzt.**		
	Int.: Die sechs Vertriebsformen wiederholen, falls erforderlich.		
	A **Direktexport**	□	
	B **Ausländische Handelsvertreter auf Kommissionsbasis**	□	
	C **Ausländische Händler**	□	
	D **Handelsniederlassungen im Ausland mit Beteiligung Dritter**	□	
	E **Eigene Handelsniederlassung im Ausland ohne Beteiligung Dritter**	□	
	F **Lizenzvergabe**	□	
	weiß nicht	□	
	verweigert	□	
41A	*Interne Frage für den Interviewer:*		
	Ist [zeige Land C] eines der Länder 1, 2 oder 3, die in der 1997er Umfrage genannt wurden?		
	Ja □		**43**
	Nein □		**42**
	Hinweis für die Programmierung		
	Diese Frage wird nur gestellt, wenn ein Land C genannt wurde. Sonst springe auf Frage 43.		
42	**Bitte geben Sie an, welche Vertriebsform Ihr Unternehmen heute in *[zeige Land C]* in erster Linie nutzt.**		
	Int.: Die sechs Vertriebsformen wiederholen, falls erforderlich.		
	A **Direktexport**	□	
	B **Ausländische Handelsvertreter auf Kommissionsbasis**	□	
	C **Ausländische Händler**	□	
	D **Handelsniederlassungen im Ausland mit Beteiligung Dritter**	□	
	E **Eigene Handelsniederlassung im Ausland ohne Beteiligung Dritter**	□	
	F **Lizenzvergabe**	□	
	weiß nicht □		
	verweigert □		
43	**Stellen Sie die Produkte oder Dienstleistungen Ihres Unternehmens ausschließlich im Inland, ausschließlich im Ausland oder sowohl im Inland wie auch im Ausland her?**		
	A **ausschließlich im Inland**	□	**46A**
	B **ausschließlich im Ausland**	□	**44**
	C **sowohl im Inland als auch im Ausland**	□	
	weiß nicht	□	**46A**
	verweigert	□	
44	**Bitte nennen Sie mir die Länder, in denen Sie, abgesehen von Deutschland, Ihre Produkte oder Dienstleistungen herstellen.**		
	Int.: Bitte die genannten Länder notieren.		
	weiß nicht □		
	verweigert □		
44A	**Wie hoch ist zurzeit der prozentuale Anteil Ihrer Mitarbeiter, die permanent außerhalb Deutschlands arbeiten?**		
	Prozent		
	weiß nicht □		
	verweigert □		
	Finanzierungsquellen		
46A	**Abschließend möchte ich Ihnen einige Fragen zu finanziellen Kennziffern Ihres Unternehmens stellen. Lassen Sie mich wiederholen, dass alle Ihre Angaben absolut vertraulich sind.**		
	Wie hoch war der Umsatz inklusive Exporte Ihres Unternehmens im Jahr 2002?		
	Umsatz in 1.000 €		
	weiß nicht □		
	verweigert □		
46B	**Bitte nennen Sie die prozentuale Umsatzrendite Ihres Unternehmens für das Jahr 2002?**		
	Prozent am Umsatz		
	weiß nicht □		
	verweigert □		
46C	**Wie wird sich nach Ihrer Erwartung Ihr Umsatz in den nächsten zwei Jahren entwickeln?**		
	Erwarten Sie ...		
	A **... eine Zunahme,**	□	
	B **... keine Veränderung oder**	□	
	C **... eine Abnahme?**	□	
	weiß nicht □		
	verweigert □		

46D	**Wie hoch waren die gesamten Bruttoinvestitionen (=Bruttozugänge an Sachanlagen) Ihres Unternehmens im Jahr 2002?**		
	Investitionen in 1.000 €		
	weiß nicht ☐		
	verweigert ☐		
46E	**Hat Ihr Unternehmen im Zeitraum seit Januar 1998 öffentliche Beihilfen erhalten, deren individueller Betrag größer als 30.000 € war?**		
	Ja ☐		46F
	Nein ☐		
	weiß nicht ☐		47
	verweigert ☐		

46F   **Bitte geben Sie an, ob Sie von den nachfolgend genannten Quellen seit Januar 1998 öffentliche Beihilfen erhalten haben, deren individueller Betrag größer als 30.000 € war, und nennen Sie mir bitte die Höhe der betreffenden Beihilfen.**

		Ja	Nein	Betrag 1	Betrag 2 in 1.000 €	Betrag 3
A	**Kommunen und Länder**	☐	☐			
B	**Bund**	☐	☐			
C	**Institutionen der EU**	☐	☐			
D	**Öffentliche Banken wie die Deutsche Ausgleichsbank, die Kreditanstalt für Wiederaufbau oder Landesförderbanken***	☐	☐			
	weiß nicht	☐				
	verweigert	☐				

* Hilfe für den Interviewer:

Sparkassen zählen hier nicht zu den Öffentlichen Banken.

47   **Im Folgenden nenne ich Ihnen verschiedene Quellen für Eigenkapital. Bitte geben Sie an, ob Sie in den letzten zwei Jahren von der genannten Quelle *zusätzliches* Eigenkapital erhalten haben.**

		Ja	Nein	weiß nicht	verweigert
A	**Eigenkapital von den Inhabern,**	☐	☐	☐	☐
B	**Eigenkapital von den Mitarbeitern**	☐	☐	☐	☐
C	**Eigenkapital von Business Angels oder externen Privatpersonen**	☐	☐	☐	☐
D	**Eigenkapital von Venture-Capital-Unternehmen**	☐	☐	☐	☐
E	**Eigenkapital aus anderen Quellen**	☐	☐	☐	☐

48   **Nachfolgend nenne ich Ihnen verschiedene Quellen für Fremdkapital. Bitte geben Sie an, ob Sie in den letzten zwei Jahren von der genannten Quelle *zusätzliches* Fremdkapital erhalten haben.**

		Ja	Nein	weiß nicht	verweigert
A	**Gesellschafterdarlehen**	☐	☐	☐	☐
B	**Fremdkapital von Business Angels oder externen Privatpersonen**	☐	☐	☐	☐
C	**Fremdkapital von Venture-Capital-Unternehmen**	☐	☐	☐	☐
D	**Kurzfristige Bankkredite einschließlich Überziehungskredite**	☐	☐	☐	☐
E	**Langfristige Bankkredite**	☐	☐	☐	☐
F	**Fremdkapital aus anderen Quellen**	☐	☐	☐	☐

Hilfe für den Interviewer (Punkte D+E):

Kurzfristige Kredite haben eine Laufzeit von weniger als 3 Jahren. Langfristige Kredite haben eine Laufzeit von drei Jahren und länger.

48A	**Wie viel zusätzliches Kapital haben Sie von den verschiedenen Finanzierungsquellen in den letzten zwei Jahren erhalten? Gehen wir nochmals die Finanzierungsquellen durch, die Sie genutzt haben. Beginnen wir mit den Quellen für Eigenkapital.**			
		Betrag in 1.000 €	weiß nicht	verweigert
	A **Eigenkapital von den Inhabern,**		☐	☐
	B **Eigenkapital von den Mitarbeitern**		☐	☐
	C **Eigenkapital von Business Angels oder externen Privatpersonen**		☐	☐
	D **Eigenkapital von Venture-Capital-Unternehmen**		☐	☐
	E **Eigenkapital aus anderen Quellen**		☐	☐

Hinweis für die Programmierung

Die einzelnen Punkte A-E werden nur gefragt, wenn der entsprechende Punkt in Frage 47 mit „Ja" beantwortet wurde.

48B	**Kommen wir nun zu den Quellen für Fremdkapital, die Sie genutzt haben. Wie in der vorangegangenen Frage, sagen Sie mir bitte, wie viel zusätzliches Fremdkapital Sie in den letzten zwei Jahren von dieser Finanzierungsquelle erhalten haben.**			
		Betrag in 1.000 €	weiß nicht	verweigert
	A **Gesellschafterdarlehen**		☐	☐
	B **Fremdkapital von Business Angels oder externen Privatpersonen**		☐	☐
	C **Fremdkapital von Venture-Capital-Unternehmen**		☐	☐
	D **Kurzfristige Bankkredite einschließlich Überziehungskredite**		☐	☐
	E **Langfristige Bankkredite**		☐	☐
	F **Fremdkapital aus anderen Quellen**		☐	☐

Hilfe für den Interviewer (Punkte D+E):

Kurzfristige Kredite haben eine Laufzeit von weniger als 3 Jahren. Langfristige Kredite haben eine Laufzeit von drei Jahren und länger.

Hinweis für die Programmierung:

Die einzelnen Punkte A-F werden nur gefragt, wenn der entsprechende Punkt in Frage 48 mit „Ja" beantwortet wurde.

Vielen Dank für Ihre Hilfe! Lassen Sie mich nochmals betonen, dass alle Ihre Angaben absolut vertraulich behandelt werden.

Später im Verlauf dieses Jahres wollen wir eine Anzahl Fallstudien mit einzelnen Unternehmen durchführen. Wären Sie bereit an einer Fallstudie teilzunehmen? Dies würde ungefähr eine anderthalbstündige Diskussion mit Mitgliedern Ihrer Geschäftsführung erfordern.

Ja ☐

Nein ☐

weiß nicht ☐

Nochmals danke für Ihre Hilfe.

Auf Wiederhören.