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**THE RAPID INTERNATIONALISATION OF HIGH TECH YOUNG
FIRMS IN GERMANY AND THE UNITED KINGDOM**

**A Summary Report for the
Anglo-German Foundation for the Study of Industrial Society**

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The views expressed remain solely those of the four authors, as is the responsibility for any errors of fact or omission in this report.

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Executive Summary

The purpose of both the quantitative and qualitative research elements of this project was to ascertain the incidence of internationalisation activity among independent German and UK high tech young firms. The research charted the occurrence, degree and speed of internationalisation by comparison to a ‘matched sample’ of non-internationalising firms. Internationalisation characteristics were then related to the performance of the firms as measured by sales and employment growth.

Key findings

- *The majority of UK and German high tech young firms will have international sales. For the typical high tech firm, it is not a question of whether, but when, to internationalise.*
- *German and British high tech young firms internationalise quickly after formation. A quarter of the sample internationalised in their first year. 80% of the sample will have internationalised by the 10th anniversary of their founding.*
- *Internationally active firms are associated with higher performance than domestic-only firms when measured by sales and employment growth and labour productivity.*
- *Firm age, size at start-up, regular R&D activity, and founders with international experience prior to start-up are each strongly and positively linked with a greater likelihood of internationalisation.*
- *Firms with highly customised products or firms which specialise in software activities are each less likely to internationalise.*
- *UK high-tech start-ups have on average higher levels of international sales than their German counterparts despite the latter internationalising more quickly.*
- *The degree of internationalisation of a firm is influenced by its management’s experience of internationalisation and by the firm’s level of co-operation with foreign partners. A firm with more experience of international sales also has a greater level of international sales.*
- *Europe is the primary regional focus for exports from German and UK firms. However, America is the most popular destination for UK exports. France is the most popular country for German exports.*
- *The founder managers of German young high tech firms are generally more risk averse than their UK counterparts. Their choice of export strategies is consistent with this greater risk aversion.*
- *Exporting directly or via a distributor are the two most common modes of internationalisation for German and UK high tech young firms and represent over 70% of all contemporary market entries.*
- *Young firms experience a ‘liability of alienness’ when trying to sell to major foreign buyers. By this term we mean that large firms are unwilling to purchase directly from young firms with little reputation or track record. This barrier tends to oblige young high tech firms to use distributors despite this channel likely being a more costly alternative to direct sales activity.*
- *Venture capitalists are confirmed as good at spotting ‘winners’. Their finance and advice raise the labour productivity of investee firms but do not significantly increase the rate of internation-*

alisation or rapid growth unless the firm has already decided to internationalise. The positive effect of venture capital advice on performance is more evident in UK firms.

- *Public grants or subsidies have little positive impacts on sales or employment measures of firm performance. There remains a wide disparity in the knowledge of, or interest in, available grant schemes among young high tech firms.*

Preface to the AGF Report

There is now a growing tradition of Anglo-German comparative research on new technology-based firms (NTBFs). Two of the most influential studies in this area have both been sponsored by the Anglo-German Foundation for the Study of Industrial Society (AGF). Starting in 1977, the first AGF project on NTBFs - *New Technology-Based Firms in the United Kingdom and the Federal Republic of Germany* - which was carried out by the consultancy firm Arthur D. Little, has been one of the most influential early contributions in the field. This report was the first public document to use the term 'new technology-based firm' and to provide a definition, which despite its operational limitations subsequently became an established term in the literature. More importantly, this study represented one of the first serious attempts to survey of the existing stock of this type of firm. It emphasised that, in comparison with the USA, Germany and the UK were each lagging behind if judged by the rate of formation of NTBFs and in their total contribution to the overall economic activity of both countries. In terms of a policy contribution, this study was instrumental in highlighting the lack of support infrastructures for the genesis and growth of high-tech start-ups in two of Europe's leading economies. Given European policy makers' contemporary concerns with international competitiveness in knowledge-based industries (see for example the UK government's White Paper on Competitiveness, DTI 1998), the 1977 AGF report was prescient in its exclusive focus on that category of new firms which is now widely regarded as having a critical role in enhancing the continued innovativeness of a developed economy.

The picture painted ten years later was a more optimistic one. A joint project, again co-funded by the Anglo-German Foundation, involved the Institut für Systemtechnik und Innovationsforschung (ISI) of the Fraunhofer Gesellschaft and the UK consultancy Segal, Quince and Wickstead (Anglo-German Foundation 1988). While more limited in scope and relying mainly on secondary data sources, this study - *New Technology Based Firms in Britain and Germany* - set another milestone. It reported a significant growth in the number of high-tech start-ups being formed in both countries, albeit with a more developed NTBF sector in the UK relative to the size of its economy. Less encouragingly, the 1988 AGF report continued to corroborate the key finding of the earlier Arthur D. Little study.

The present (and third) report - *The Rapid Internationalisation of High Tech Young Firms in Germany and the United Kingdom* - can be seen as continuing in the same tradition and is a direct successor to these previous projects. Its subject continues to be NTBFs in Germany and the UK. However, the present report specifically concentrates on the processes and implications of the internationalisation of technology-based young firms. In an increasingly interdependent world economy, the study of how firms internationalise both their markets and the means of production has become a major part of the canon of business studies.

This 2000 AGF report demonstrates that international sales activity is not the exception but, statistically, is the norm for UK and German NTBFs. While young and small firms are generally characterised as less likely than older or larger firms to undertake overseas sales activity, technology-based young firms are seen to present a major and important qualification to this rule. The dynamics and speed of foreign market entry of NTBFs are typically of an order faster than their more established or less technology-focused firm counterparts. Indeed, these European firms, when matched by age and sector, are likely to be more international or even on occasions more global than their NTBF counterparts in the US.

The subject matter and findings of this report are highly germane to the present debate on the competitiveness of European economies. One particular contemporary concern of policy makers is the dearth of large companies which have been born of major technological developments in the last twenty years. With very few exceptions, Europe has negligible equivalents to the global technological giants of Microsoft, Oracle, Dell, Cisco AOL etc. that seemed to have found such a conducive start-up and rapid growth environment in the USA. Thus, national policy makers have become interested not only in the numbers of new firm formed but also in how many of these firms will continue to enjoy rapid growth over several years in order to have a chance of reaching major international importance.

Objectives of the Research Project

The research project had four related and highly specific objectives:

Firstly, the authors wished to ascertain in detail the *degree of internationalisation* activities among NTBFs in Germany and the UK. The present study is, to our knowledge, the largest empirical study of its kind undertaken with German and British NTBFs. Anecdotally, it is not difficult to appreciate the international scope and experience of those managers and scientists who create and work in NTBFs. However, anecdote is an insufficient foundation for analysis. Subjective impression can now be corroborated with substantial quantitative and qualitative data across two major European economies.

Secondly, the authors sought to go beyond descriptive statistics to look at *causal* relationships. By using a 'matched sample' methodology, the Anglo-German research team was able to ascertain a number of firm characteristics which can be successfully used to discriminate between companies which did internationalise and those which did not. Econometric analyses allowed the data to be interrogated in order to link the firm's predisposition for international activity to a number of contemporary and competitive theories in business strategy.

Thirdly, by linking causal relationships to a more detailed investigation of the alternative modes of internationalisation chosen by both German and British young firms, the researchers desired to be able to build up a level of knowledge of direct value and applicability to young firms seeking to internationalise for the first time. The findings drawn from the survey and interview information were not restricted to issues only of academic and theoretical interest. The research team was mindful that information of practicable and pragmatic advantage to NTBFs or their advisors was of equal value to observations of purely theoretical importance. To ensure the validity of the wider survey findings, forty case studies were undertaken with selected and matched survey respondents. By this means, the generalised conclusions from the survey material could be explored, challenged or corroborated by detailed debate with owner-managers of NTBFs. The resultant findings, which will be communicated to NTBFs and especially the respondents who participated in the survey, will also be made available to the wider business community. One important group within this community will be the small business advisers and other public advisory bodies interested in fostering high tech enterprise. It is for this reason that both the German and British industry ministries are directly or indirectly sponsors to this research.

And finally, the over-arching objective of the project was to undertake cross-country research of the highest level of academic rigour, as judged by our peers and sponsors, while at the same time being of direct and material value to the founders and managers of NTBFs, small business advisers and industrial policy makers in the host countries of the United Kingdom and Germany.

It is up to our readers to determine whether or not the objectives that we set ourselves have been satisfactorily met.

1 Introduction and Research Dimensions

1.1 New Technology Based Firms, High-Tech Start-Ups and Globalisation¹

In recent years, much of the debate of policy makers, business academics and practitioners alike has centred on the nature and implications of the increasing importance of trans- and multi-national, economic activity. Globalisation, the phenomenon of increasing economic interdependence across national borders, is believed to be particularly pertinent to high-technology industries. These sectors are commonly characterised by high costs for research and development, decreasing product and technology life cycles and strong competition from foreign firms (Oahey 1984, Porter 1986, Bartlett and Goshal 1989, Kobrin 1991). Strategies that large multinationals have followed to react to the 'forces' of globalisation have included, for example, international expansion to achieve economies of scale and simultaneous product launches in several countries in order to maximise international returns in dynamic markets subject to fierce and immediate competitor responses. International sales strategies have ranged from exporting and co-operative arrangements, such as joint ventures and licensing, to the more resource-intensive alternative of foreign direct investment.

Each of these strategies requires additional managerial and financial resources. This is because firms operating in foreign countries have to face a number of conditions that can put them at disadvantage to indigenous competitors. These conditions, which impact negatively on their trading opportunities, include lack of information about the particular foreign business environment, different market regulations that have to be taken into considerations, and the different social norms that influence how business is conducted in culturally disparate countries. The adaptation to these novel circumstances represents an economic and time cost that all firms - irrespectively of their size - have to bear when engaging in cross-border activities. Substantial efforts have been made in the last decade to harmonise the regulatory environments under which world trade is conducted. This can be seen especially in the actions of the European Union to create a Single European Market or the creation of the North Atlantic Free Trade Association. It is also observable at a global level through the increasing liberalisation of trade in goods, and more recently in services, through the multinational General Agreement on Trade and Tariffs (GATT) and the World Trade Organisation (WTO) negotiations. None the less, despite these initiatives to harmonise markets, cross-border activities still represent an area of increased and significant risk and uncertainty - especially for small and young firms.

Therefore, the question arises as to how can NTBFs, the smallest players in the high-technology sectors, cope with these challenges? Can these firms sustain resource-intensive entry modes in order to establish an international presence? Conversely, do they have to place their bets on 'second-best strategies' aimed at surviving in the long term as domestic, niche producers? Alternatively, have some NTBFs managed to find innovative ways of overcoming or better managing the costs and uncertainties traditionally associated with internationalisation? Growth through international expansion might be a realistic option for some firms but not a viable commercial route for others. What characteristics distinguish NTBFs with international activities from those NTBFs which choose to compete solely within a domestic setting? What internal and external barriers have been encountered by internationalisers and non-internationalisers? What impact does internationalisation have on firm performance? Does public policy have an effective role in increasing the export activities of international NTBFs or in encouraging those firms serving only domestic markets to start internationalising? These specific and inter-related issues represent the central themes and questions that this project sought to examine and resolve in both Germany and the UK.

¹ Note that the two terms 'new technology based firm' (NTBF) and 'high-tech start-up' will be used interchangeably in this report.

1.2 The Importance of NTBFs

Since the late 1970s, small and medium sized enterprises (SMEs) have been seen as an increasingly important policy vehicle for economic development goals within advanced Western economies. This broadening of industrial policy to include SMEs as a complement to the historically predominant focus on larger, and thus more visible, firms was given a major impetus by Birch's study at MIT (Birch 1979). Birch and his co-workers argued that two-thirds of new jobs in the USA over the period of 1969-76 were a direct result of the expansive economic actions of small firms with under twenty workers. Birch's methodology, and especially the assumptions of his model, have engendered considerable academic debate². However, his central findings which illustrate the continuing and pivotal importance of SMEs to a successful modern economy obtained widespread recognition and acceptance by policy makers both within and outside the USA.

This governmental interest was not ideological in nature but was fuelled by an increasingly pragmatic recognition of both the actual, and potential future, contribution of SMEs to total employment and to the net creation of new jobs (Birch 1979, Gallagher and Stewart 1986, Storey, Watson and Wynarczyk 1989). In a European context, the European Union embraces approximately 17 million enterprises within its fifteen member states. Revisions in thinking about the SME sector's economic (and social) value included a new understanding of their centrality to the continued adaptation of European businesses in the novel competitive landscape of the 'knowledge economy' (Bettis and Hitt 1995, European Commission 1994 and 1995). SMEs have now become one firmly established focus of the European Commission's economic, technological and regional development policies as evidenced in their policy statement, *The First Action Plan for Innovation in Europe: Innovation for Growth and Employment* (EC 1997), and the subsequent 5th Framework Programme.

The renewed attractiveness of SMEs was in part a consequence of the recognition that domestic industrial policy, be it explicit or implicit, could not be left exclusively dependent on the fortunes of a relatively small number of large, and increasingly globally organised, corporations. Large firms in traditional industries or even national champions like, for example, Siemens in Germany, Rolls Royce in the United Kingdom and Fiat in Italy, could not meet fully the expectations of domestic governments and their electorates for sustainable high levels of employment in addition to growing real national incomes. Indeed, from the late 1960s, several internationally known and respected, large pan-European companies appeared increasingly vulnerable in industrial and consumer product markets now frequently dominated by Asian or American suppliers.

If revised expectations have been placed on the aggregate contributions of small and medium sized enterprises to a modern economy, the highest hopes have been reserved for New Technology Based Firms. Within the wider corpus of small businesses, NTBFs continue to represent a peculiarly attractive focus for policy makers. They are seen as offering significant potential benefits in four cardinal areas of policy interest: employment creation; innovation (including the effective dissemination and commercialisation of new ideas - particularly out of universities); export sales growth; and regional development (Rothwell and Zegveld 1982, Freeman 1983, OECD 1986 and 1997, Oakey, Rothwell and Cooper 1988, Rothwell 1989, Roberts 1991, Confederation of British Industry 1996, Coopers and Lybrand/NVCA 1996). The 1988 Anglo-German Foundation report on NTBFs also lays stress on the potentially complementary relationship between NTBFs and large, science-based firms. However, this report was candid in noting that many of the posited benefits are based on a longer American experience and remained, as yet, not fully demonstrated in Europe by the late 1980s.

Just as Birch is credited with a major role in bringing the importance of SMEs to the fore within US public policy programmes, Americans are also seen as the primary progenitors of an élite cadre of large, trans-national, technology-based corporations. These enormously successful and often relatively young corporations owe, in significant part, the conditions of their existence to the US government's very material support for science-based and defence-related technological advances which have been discovered and/or developed since World War II. International interest in the regional development role of NTBFs has in part stemmed from an appreciation of their critical role from the early

² Storey (1994a) concisely reviews the development and countervailing arguments of this debate.

1970s in the economic growth of concentrated areas of high technology activity in the USA, particularly Silicon Valley, California and Route 128 around Boston, Massachusetts (Oakey 1984, Florida and Kenney 1988, Roberts 1991, Bygrave and Timmons 1992, Kenney and von Burg 1999). More recently technology 'clusters' have also included Seattle, Houston and the North Carolina 'triangle'. Although to a lesser degree, there is now also a growing body of evidence of NTBFs' contribution to fast growth European regions (Meyer-Krahmer 1985, Keeble 1989 and Murray 1998).

While job creation may be the 'pay dirt' of an economic policy, such an outcome has to be underwritten by one or more forms of sustainable economic advantage (Porter 1985). The contribution of NTBFs to both net employment and firm formation has been shown by Storey and Tether (1998) to differ during the development and evolution of a technology sector with the rates of both job and firm formation both increasing and decreasing at different times. However, regardless of the developmental stage of a sector, its ability to create jobs remains a function of its innovative capability. The small size of NTBFs relative to their established competitors can convey significant structural advantages in both the creation and bringing to market of new innovative products and services. This advantage may be articulated at the firm level (Rothwell and Zegveld 1982) and/or the industry level (Acs and Audretsch, 1990, Utterback and Suarez 1993). However, the advantages of flexibility and closeness to market should not blind observers to the fact that NTBFs remain particularly vulnerable in their early years to a range of both endogenously and exogenously sourced risks (Westhead and Storey 1997, Murray and Marriott 1998). Innovation, flexibility and a closeness to target markets cannot necessarily protect NTBFs from large, established and aggressive market incumbents particularly when the competitive threat of the new entrant is fully appreciated.

Recognition of the NTBFs' advantages conveyed by small size (flexibility) and singleness of purpose (focus) has also resulted in NTBFs becoming attractive, and thus highly priced, acquisition targets for large, technology-based firms anxious to secure and exploit a stream of future innovations within their own core products and markets. The recent growth in the number and value of early-stage funds managed by technology-specialist venture capitalists in Europe (EVCA 1998), the growth in trade sales as the predominant exit for successful technology-based investee companies, and the renewed popularity of corporate venturing activities by established large firms (Block and McMillan 1993, McNally 1994, Gompers and Lerner 1998) are each indicative of the present attraction of NTBFs' innovative capabilities to larger firms.

Policy makers in both Europe and America can compare and contrast the economic growth and sustainability of cities such as Cambridge UK, Munich, Milan and Grenoble with their depressed, counterpart regions in which the surviving remnants of Europe's iron and steel, coal and other heavy industries are situated. Par excellence, the techno-economic powerhouse of Southern California with its formidable network of established and new technology-based firms and the attendant concentration of support industries and services has become the contemporary exemplar for policy makers (Saxenian 1994, Kenney and von Burg 1999). Accordingly, the aspirations and expectations now placed on young technology based firms are extraordinary. Few would herald the opening a small local grocer with expectations that it could become the Marks & Spencer or the Wal-Mart of the next decade. Yet, there is, in a very real sense, an implicit but no less fervently considered, aspiration by the backers of an NTBF that it might just become the next Intel, Nokia, Cisco, SAP or Amgen. The recent meteoric growth in 1998/99 stock market valuations of internet-based, 'dot.com' stocks including Yahoo, Amazon, E-Bay and Broadcast (in the case of all but Yahoo, based entirely on future expected trading profits) has done nothing to ground expectations in realism. Even the more recent stock market corrections in Spring 2000 have not completely curtailed the very high levels of investors' expectations from technology stocks.

However, while successful NTBFs potentially offer very material advantages to the economic prosperity of a location, their genesis and early years are commonly fraught with extremely high levels of uncertainty and risk. This situation reigns in virtually all areas of NTBF activity including financing, technology and marketing (Oakey 1984, Roberts 1991, Murray 1994 and 1995, Westhead and Storey 1997, Murray and Marriott 1998, Storey 1998). For the individual NTBF, an exceptional technological offering is a necessary but not sufficient condition for economic success. Its entrepreneurial founders have also to manage organisational and product/market demands in both internal and external en-

vironments characterised by their complexity and rapid rate of change. In essence, the universe in which an NTBF typically operates is commonly defined by high levels of risk and uncertainty.

Despite their putative attraction to a wide range of stake holders, NTBFs labour under very similar constraints to the majority of all SMEs. Financing difficulties are particularly acute for NTBFs on formation and at their earliest stages of development (Roberts 1991, Moore 1994, Murray and Lott 1995). Limited tangible assets reduces their opportunity for collateral based lending from retail banks, which is the predominant source of external finance to European SMEs (Storey 1994b). The economic value of intellectual property rights created by the entrepreneur is, as yet, unproven and thus unexploitable (Rumelt 1984). The ability of new entrepreneurs from a technology/scientific background to attract external equity finance, i.e. formal venture capital, is also prejudiced by their frequent lack of commercial experience and the absence of an established track record of successful enterprise (Tyebjee and Bruno 1984, MacMillan, Siegal and Narishima 1985, Goslin and Barge 1986). In consequence, owner-managers of NTBFs are, per force, very heavily dependent on own and family personal finance for initial capitalisation (Oakey 1984, Roberts 1991, Moore 1994) in addition to relying on trade credit and, to a lesser extent, government grants (Utterback, Meyer, Roberts and Reitberger 1988, Moore and Garnsey 1991).

The imperfections of capital markets have featured largely in the debates on SME developmental constraints. The proposition of the existence of an 'equity gap', i.e. a market failure in the adequate provision of small amounts of external risk capital for young and growing firms, has been part of the economic literature for over 60 years (see The Macmillan Committee 1931). A succession of official committees and research exercises since that date (e.g. Bolton 1971, Wilson 1979, Bannock 1991, Confederation of British Industry 1993, OECD 1995, Bank of England 1996) have each cited evidence of the existence of equity gaps and their deleterious effect on the viability of smaller businesses. These firms are generally characterised as having weaker liquidity, more volatile levels of profitability, an over-dependence on short-term sources of finance and an insufficiency of shareholders' funds or equity. NTBFs are seen as particularly vulnerable to financial constraints given that initial investment costs, particularly R&D, are incurred before any prospect of consequent revenues. In addition, the assets of the NTBF are intangible and, at least initially, unproven both technically and commercially. Even when proven, the real value of an NTBF often lies in the unique skills and experience of its staff. This 'tacit knowledge' is unavailable to any creditors in the event of a loan default. The peculiarly intangible nature of key assets and sources of competitive advantage in knowledge-based firms, coupled with the frequent absence or limited availability of traditional collateral, makes the young NTBF's use of debt based instruments often highly problematic.

1.3 Theoretical Dimensions of Internationalisation

Conceptual Frameworks

Theoretical frameworks for the analysis of international business are well developed in managerial literature as well as in the economics literature (see Oviatt and McDougall 1994 for a review). Most prominent are internationalisation process models including stage models (Johanson and Vahlne 1977, Cavusgil 1980), monopolistic advantage theory (Hymer 1976), internalisation and transaction cost theory (Buckley and Casson 1976) as well as oligopolistic behaviour theories (Knickerbocker 1973). In addition, there are frameworks addressing a broader scope of issues such as such Dunning's ideas put forward in various papers (e.g. Dunning 1980) which incorporates elements of monopolistic advantage, internalisation and international trade theories. More recent, the export management and the new trade theories also addresses the question of international business (see Leonidou and Katsikeas 1996, Bernard and Jensen 1999). For the purpose of explaining international entrepreneurship, we believe that monopolistic advantage, transaction cost and internationalisation process models are the most relevant theoretical frameworks.

The process model concentrates on the managerial aspects of internationalisation. Timing of market entry, the structural forms of foreign operations and their evolution over time are seen as functions of

the increasing experience and subsequently greater commitment of managers to foreign markets. Monopolistic advantage and internalisation theories, conversely, originally tried to explain why multinational corporations exist as institutional forms for organising international production. These theories look at different aspects of internationalisation and try to answer different questions. So, the theories should not be viewed as contradictory frameworks but as models addressing complementary aspects and various dimensions of international entrepreneurship.

Internationalisation process models see internationalisation as an incremental process of increasing commitment to foreign markets (Johanson and Vahlne 1977 and 1990). The mechanism behind this increasing involvement is seen as result of a circular learning process. A basic assumption is that firms have to deal with additional costs and uncertainties when entering a foreign environment. These are caused by, for example, material differences in the business culture, language, market structures etc. According to Johanson and Vahlne, firms overcome these disadvantages by gaining direct experiential knowledge of foreign markets over time. This knowledge, derived from the current international activities, positively feeds back to the decision to commit resources for future activities and results in a steady increase of commitment to the foreign market. According to this view, a firm starts its internationalisation in markets with the lowest perceived uncertainty (or lowest psychic distance) using an entry mode that requires relatively few resources, such as exporting. Better and greater knowledge is acquired over time through operating in that market. Accordingly, uncertainties and information costs that were present prior to the initial investment decrease. Based on the new knowledge, the firm reassesses its position and may increase its involvement in the foreign environment. The initial involvement reduces uncertainty which then may lead to an increasing commitment and a scaling up of the foreign operations towards more resource-intensive modes. Furthermore, the knowledge acquired during the first foreign market entry influences the choice and entry mode for subsequent markets.

Johanson and Vahlne's work provided the basis for extensive empirical research from numerous scholars in different countries. Known under the heading "*stage models*" of internationalisation, they support the view of internationalisation as an incremental process (Bilkey and Tesar 1977, Bilkey 1978, Cavusgil 1980, Reid 1981, Wortzel and Wortzel 1981, Czinkota 1982, Barrett and Wilkinson 1985, Moon and Lee 1990, Lim, Sharkey and Kim 1991, Rao and Naidu 1992, Crick 1995). All of these studies argue that internationalisation behaviour is best represented by invoking distinct stages in a firm's life which start from no foreign involvement and increase to the final state of foreign direct investment. The methodological foundations of empirical studies using this concept have frequently been subject to strong criticism (Turnbull 1987, see also Andersen 1993; Leonidou and Katsikeas 1996 for reviews). Critics point out that stage models are tautological. Instead of reflecting increasing commitment to internationalisation, the different stages are direct results of the classification criteria used by the researchers. Their arbitrary definition makes it difficult to delimit the stages. In addition, all studies have been derived from cross-sectional samples which makes it impossible to analyse the temporal and causal logic behind the internationalisation process. While it is accepted that internationalisation may not proceed in distinct and predetermined stages, the basic logic behind the internationalisation process developed by Johanson and Vahlne is arguably still a powerful model of the dynamics within the internationalising firm (Melin 1992).

In **internalisation theory**, the decision to internationalise is taken as given. According to this perspective, firms build up facilities abroad when the costs associated with arms-length transactions in the market place, for example exporting, are higher than the costs associated with internal transactions (Buckley and Casson 1976, Hennart 1989). In this case, the international growth of a company is achieved through the displacement of cross-border markets, which operate in a less efficient way than cross-border hierarchies. Internalisation theory is thus primarily an attempt to explain foreign direct investment as an operating mode of international business.

The theoretical core of internalisation theory, **transaction cost economics** (TCE), explicitly aims to compare the efficiency of particular governance modes (Williamson 1985). Its main application to the field of international business is concerned with the choice of the optimal market entry modes and not with the decision to compete abroad *per se*. In essence, TCE makes the behavioural assumptions of bounded rationality and self interest which may lead actors to behave opportunistically. Safeguarding against these risks when dealing with a partner as opposed to carrying out the transaction within a hi-

erarchy gives rise to transaction costs (Williamson 1985). Situations where bounded rationality and self interest are particularly problematic arise in the presence of asset specificity or uncertainty resulting from information asymmetries (Williamson 1985, Anderson & Gatignon 1986). Asset specificity occurs when one party to the transaction has to invest in co-specialised assets to make the relationship work (Teece 1986). This party can subsequently be taken hostage by the other contracting party due to the sunk costs involved in the arrangement. Contracts can be devised to minimise the risk of shirking by one of the parties. Yet, it is unrealistic to attempt to specify a situation entirely. Furthermore, the costs of devising such contracts as well as monitoring and enforcing them may be prohibitive for both parties. Asset specificity, uncertainty and information asymmetries between buyer and seller are particularly pertinent in high-technology industries. TCE theorists argue that, in the presence of these conditions, it is more efficient to carry out economic activity within a hierarchy rather than to deal with a partner. Since the firm's advantage over markets lie in its ability to set incentives, monitor progress, settle disputes and refine rewards (Mahoney 1992), firms that face these conditions are expected to carry out international activities without involving intermediaries (i.e. direct exporting or direct investment in sales subsidiaries). Note that this implication is in stark contrast with the internationalisation process logic which sees first-hand experiential knowledge as a determinant of the entry mode choice. The theory suggest that there may be situations, where very innovative start-up companies operating at the forefront of technological developments can only appropriate rents for their activities through internalised transactions. Furthermore, transaction frequency and the pre- and after-sales service requirements may require local presence instead of arms-length exporting. Yet, the average start-up will rarely have the financial resources to set up a wholly-owned foreign subsidiary. As a result, we end up with a dilemma where, on the one hand, TCE and internalisation theories may recommend under certain conditions that the start-up internalises a transaction in order to minimise the risk of market failures typically associated with high-tech environments. On the other, the average start-up lacks the substantial resources required to effect practicably this theoretical prescription.

Monopolistic advantage theory and resource-based approaches (RBV) might represent a useful platform to reconcile process models and transaction theory. Monopolistic advantage theory holds that a firm can generate higher rents from the utilisation of firm specific assets which cannot be replicated by other firms (Hymer 1976). The rents that stem from this quasi-monopoly can then be used to offset the higher costs of competing abroad. Monopolistic advantage can be view as a predecessor of the resource-based view of the firm (e.g. Wernerfelt 1984, Peteraf 1993) and more recent approaches that see organisational capabilities (OC) as important determinants of organisational outcomes (e.g. Kogut and Zander 1996, Teece, Pisano and Shuen 1997). Based on Penrose's notion of the firm as a bundle of assets, the resource-based view of the firm argues that organisational performance is a function of the internal assets of a firm. If these resources are matched appropriately to the external environment, then the firm may command a competitive advantage over its rivals. Resources include both physical resources and intangible resources. While the former can be more easily obtained and imitated, it is especially the latter that differentiate a firm from its rivals. They include management skills, brand names, unique processes, organisational culture and the tacit knowledge of employees. It is this idiosyncratic bundle of intangible resources that will determine how the physical resources will be deployed and thus lead to firm-specific returns.

International activities would then be determined by the resources and capabilities that a firm possesses and that allow it to overcome the initial costs of competing in foreign environments. This would apply in the case of a young, highly specialised company offering an innovative solution that no competitor can match. This solution might stem from a product or process innovation, it might be an innovative product or service or even an organisational ability (such as a particular competitive behaviour, i.e. selling goods over the internet thus saving distribution time and cost). At a given moment in time, when no competitor can provide a solution that is of equal value for the customer or at similar price, it becomes possible to envisage a small start-up company leveraging this solution into foreign markets despite its higher costs relative to domestic operations. The costs of internationalisation can thus be offset either by above-average returns due to the inability of rivals to provide an equal solution.

One can conclude that different theories lead to conflicting prescriptions when the firms in question are simultaneously young and operating in high-technology industries. On the one hand, according to

internationalisation process theory and stage models, small start-ups are hardly expected to engage in international activities. Exceptionally, if they do so, they are expected to choose entry modes which require few resources. Conversely, internalisation theory takes the decision to internationalise as given and expects that firms operating in high-tech industries would, under certain conditions, choose quite resource intensive entry modes. A resource-based perspective could provide a bridge between these two arguments and link the decision to internationalise and the chosen entry modes to the resource endowments of the firm. An empirical comparison between the characteristics and behaviour of internationalisers and non internationalisers could therefore help uncover which of these perspectives contribute most to the internationalisation decision.

Empirical Studies in International Entrepreneurship

Despite the established status of internationalisation as a field of study, surprisingly little research has been conducted into the detailed processes by which young and high-technology companies have internationalised. Observations that these firms engage in cross-border activities from a very early stage of their existence represent an interesting challenge for the established body of theory in the area of international business. Research activity in this field has historically been strongly oriented towards large firms or 'traditional' smaller firms. When the firms under scrutiny are at the same time young and high-tech, established theories warrant conflicting prescriptions. Behavioural theories (Johanson and Vahlne 1977 and 1990) argue that internationalisation is a slow and incremental process whereas economic theories (Buckley and Casson 1976, Cantwell 1991) do not rule out rapid and resource-intensive internationalisation. Thus, when it comes to the internationalisation of NTBFs, it is possible - depending on the theoretical perspective that is chosen - to explain why some start-ups engage in cross-border activities whereas others stay domestic. However, these theoretical rationalisations can only be employed *ex-post*. They have no predictive power to determine which firms are likely to internationalise or stay domestic. Explanations without predictive power have little value to either academics or practitioners.

Our unsatisfactory understanding of internationalisation processes, and particularly as they relate to the actions of NTBFs, is worrying. There is a compelling case for further research embracing both theoretical and pragmatic goals. As previous academic enquiries into this area have primarily been exploratory in nature (see MacDougall, Shane and Oviatt 1994, Murray 1996, Boter and Holmquist 1996), the present authors proposed a systematic investigation of the determinants of cross-border activities of start-up and young companies in high-technology sectors. In the most thorough study on this topic known to the researchers (Lindqvist 1991), variables that have previously been seen to correlate with the internationalisation of traditional small firms, such as technology intensity, firm size and ownership structure were found not to contribute to explanations of the international activities of small high-tech firms. Even though the firms included in the sample exhibited a relatively heterogeneous internationalisation pattern. Lindqvist failed to show any significant correlations between these variables and the chosen performance indicators.

Therefore, the scant empirical evidence in this area suggests that our understanding remains incomplete and often rudimentary. Particularly, there is a dearth of large scale, survey based studies with a specific focus on NTBFs. Furthermore, on the theoretical side, one can observe the conflicting prescriptions of behavioural and economic theories which are founded on observations of either large or small traditional firms. Accordingly, the Anglo-German research team proposed a detailed investigation into the determinants of cross-border activities of NTBFs. The study was to be specifically designed to address the actions and beliefs of the management of NTBFs. Of critical importance was the early decision of the researchers that the study would include data from both internationalising and non-internationalising new technology-based small firms. This 'matched sample' methodology was expected to contribute to a better understanding of the applicability of growth and internationalisation theories to this sub-set of firms.

The two tables below provide a synopsis of the contemporary research work in the area of international entrepreneurship. Evidently, there is a dearth of large scale, survey studies which have focused on the processes of internationalisation as they specifically affect new technology based firms.

Table
Overview of Quantitative Research (Surveys) in International Entrepreneurship

Authors	McDougall	Lindqvist	Bell	McDougall & Oviatt	Bloodgood, Almeida & Sapienza	Reuber & Fischer
Year published	1989	1991	1995	1996	1996	1997
Number of surveyed firms	188	95	98	62	61	49
Industry	IT/Comm. Hardware	Various High-Tech	Software	IT/Comm. Hardware	Various Services and High-Tech	Software
Mean firm age	n.a.	12	n.a.	4	< 5 years	11
Mean firm size	n.a.	56	n.a.	22.6	1668	41
Explicit focus on international new ventures	yes	no	no	yes	yes (?)	no
Key findings	domestic and international ventures differ in terms of industry and strategy profile, notion that INVs are different	observed rapid internationalisation, but market selection and entry modes in line with internationalisation process theory	stage models cannot account for foreign market selection and entry mode	international new ventures have higher levels of market share, but not ROI, Increased international sales only lead to increased performance when accompanied by strategic change	international work experience of managers, product differentiation and firm size are positively relative to internationalisation, level of internationalisation at IPO is positively related to earnings 2 years later	international experience of management, mediator effect of internationalisation behaviour which in turn positively influences the firm's degree of internationalisation

(Based on Bürgel 1999)

**Table:
Overview of Qualitative Research (Case Studies) in International Entrepreneurship**

Authors	Lindqvist	Jolly, Alahuhta and Jeannet	McDougall, Shane and Oviatt	Bell	Coviello & Munro	Boter & Holmquist	Murray	Roberts & Senturia
Year published	1991	1992	1994	1995	1995	1996	1996	1996
Number of Cases/Interviews	15	4	24 (12 indirectly from secondary sources)	24	4	6	6	19
Industry	Various High-Tech	IT/Com. hardware	Various industries, mainly technology intensive	Software	Software	“innovative”, “conventional”	Various High-Tech	IT hardware and software
Firm Age	6-25 years	<= 8 years	n.a.	n.a.	10-15	10-15 *	4-10	n.a.
Firm Size	7-135 employees	n.a.	n.a.	n.a.	25-250	8-180	12-155	n.a.
Explicit Focus on international new ventures	No	yes	yes	No	yes	no	no	no
Key findings	Evidence of rapid internationalisation with strong resource, but stronger commitment form larger and older firms	Reports the case of four small start-ups that became global players, they now perform different activities of their value chain in different countries	Established theories of international business fail to explain the formation of international new ventures	Stage models cannot account for foreign market selection and entry mode	“Random” involvement in foreign markets can be attributed to network of contacts.	internationalisation should be understood in industry context, all innovative companies were more pro-active internationalisers	international experience of founder, international and industry experience of key managers	More rapid and bolder resource commitment than expected by international business theories, but: incremental pattern
Other findings	strongest commitment in firms with executives with international and industry experience	international vision, standardised products, innovative products based on industry shift, speed, follow-up products	background of the entrepreneur, his international vision and network are important determinants	product standardisation	Heavy reliance on network relationships for marketing related activities	concentrated product scope, background of managers	deliberate targeting of large and growing US market, international competition, complacency of incumbent large firms	standardisation, founders’ international experience, higher commitment leads to higher foreign sales, replication of domestic business model

*innovative firms only, (Based on Bürgel 1999)

1.4 Policy Dimensions

Research studies both in the US and Europe have concluded that new technology-based firms are a source of important innovations and high-quality employment, in addition to highlighting their contribution to regional and structural adjustment (see for example Rothwell and Zegveld 1982, Piore and Sabel 1984, Kulicke 1987, Garnsey and Cannon-Brookes 1993, Westhead and Storey 1994). Yet, researchers and practitioners alike have repeatedly observed that the hugely impressive success-stories of US firms like Cisco, Oracle, Compaq, Intel and Microsoft, which rapidly³ grew from start-ups to become dominant industry players, have very few parallel among European firms. When performance is measured in the aggregate numbers of firms and jobs created, Europe continues to lag behind the US (Coopers and Lybrand 1996, Storey and Tether 1998). Cultural differences, legal constraints, fiscal regimes un conducive to entrepreneurial activity, the limited availability of early-stage risk capital, and an insufficient infrastructure of second-tier financial markets are each frequently cited as instrumental reasons for this failure (Anglo-German Foundation 1988, Murray and Lott 1995, European Commission 1995, Storey and Tether 1998, DTI 1998 and Williams 1998.)

Some of these issues are currently being addressed by policy makers. European based stock markets specialising in trading in innovative young companies, including the Alternative Investment Market and the TechMARK⁴ in the UK, the Nouveau Marché in France, the Neuer Markt in Germany and EASDAQ, have all been established in the last decade in order to assist rapidly growing firms in accessing public sources of finance. These moves reflect the admiration evinced in Europe for the seminal performance of the NASDAQ market in the US in attracting and financing large numbers of high quality NTBFs (Graham Bannock and Partners Ltd. 1994). In addition, the First Action Plan for Innovation in Europe launched in 1997 by the European Commission (EC 1997) has the stated goal of simplifying and harmonising the administrative environment for high-technology start-ups in its member states.

Finally, European venture capital markets have seen an influx of new finance from overseas investors which implicitly assumes that European NTBFs are under-priced.⁵ Yet, investment executives from domestic venture capital funds simultaneously claim that European countries lack sufficient high quality entrepreneurs who can combine both technological and managerial expertise to create exciting new companies. In their view, it is not a supply-side failure in the market for venture or risk capital but a demand-side problem. Accordingly, venture capitalists argue that future policy initiatives should be geared towards increasing the supply of experienced and professional 'investment ready' entrepreneurs in which they can confidently invest (DIST 1997, Storey and Tether 1998). In the present authors' view, there are merits to the arguments for both supply and demand side failure. Until the second half of the present decade, the European venture capital industry could have been said to have largely abandoned technology investments, particularly at the earliest stage of seed or start-up investing⁶. Similarly, too many of the applicants for venture capitalists' money are insufficiently well prepared to reasonably expect professional investors' support.

³ The term 'rapidly' needs clarifying in the light of contemporary experience with e-commerce related businesses. Bhidé (2000) notes that some of the most successful firms in US history, including Microsoft and Hewlett Packard, had significant gestation periods and were not overnight successes. Given the extremely variable commercial performance of e-commerce enterprises to date, extreme caution is necessary in making any assumptions regarding the changing rate of firm success.

⁴ Started operating in the UK in November 1999.

⁵ Since 1998, a number of very large venture capital funds (>€1 billion) being set up in Europe by US venture capitalists to target both early and later stage deals on a trans-continental basis.

⁶ By general consensus among venture capitalists, the provision of sums of finance below £1,000,000 is increasingly difficult for a fully commercial fund.

Research on the characteristics of successful high-tech entrepreneurs⁷ originates mainly in the United States and has been characterised until recently by a remarkable absence of European scholarship (Shane 1997). While we do not argue that American prescriptions are not applicable in a European context, we would, nonetheless, like to highlight a very particular issue. Given the size of the US market, it is possible for a new American enterprise to sustain high growth rates over several years *entirely* through domestic operations. In a European context, characterised by the smaller size of national markets, a producer of highly specialised, advanced technology products or services may achieve comparable growth in the longer term only through international expansion. However, in order to engage in cross-border activities, a European entrepreneur may require additional skills other than those assumed in the US research literature. The basic requirements of exceptional technological expertise and sufficient commercial acumen to start and grow a new business are necessary but not sufficient. In addition, the European technology entrepreneur must cultivate the ability to be understood and accepted in order to operate effectively in a range of disparate, national cultural, legal and commercial environments.

Thus, 'soft' trans-national, social or networking skills may be a further demanding precondition for the entrepreneurial managers of European NTBFs if they wish to achieve economic successes comparable to those of their American counterparts. Rigorous empirical research in this area, which encapsulates and interprets the experiences of NTBF internationalisers, may have two valuable roles. Research findings can be disseminated directly to NTBF managers who are already international, or who would like to internationalise their activities. Secondly, any identified factors which either promote or inhibit overseas activity can be used to inform public policy initiatives aimed at improving the quality and supply of European entrepreneurs.

1.5 Managerial and Operational Dimensions

Insufficiently diversified start-ups which base their business on one or a small number of products or services are characterised by a high exposure to risk. Niche producers always run the risk that they have chosen a market focus that turns out to be irrelevant or quickly superseded. Further, given the rapidity with which concatenated technology trajectories merge, the superior economic rents gained by an innovative NTBF from a temporarily dominant market position can be, and very often are, quickly eroded. The entry of one or more competitors with a cheaper offering and/or products providing greater functionality but at a comparable price, or the ultimate substitution of the NTBF's products with alternatives based on a superior technology⁸ (Roberts 1991) can each rapidly precipitate the failure of the incumbent firm. Thus, to even have the chance of achieving long-term viability in fast changing technological environments, a start-up needs to have substantial initial finance. In the absence of sufficient start-up finance, the firm must be able to generate rapidly significant additional follow-on funding in order to finance the development of further applications of their base technology.

In addition, the young and growing firms also face the short-term necessity of recovering the initial costs of development, prototyping and commercialisation of their products. These finances may have been generated internally or externally. In the former case, if the venture is not in a position to sustain a premium price strategy to collect above-average (quasi-monopoly) rents over a long period of time, this objective can only be met through rapid sales expansion. However, this strategy is almost invariably cash consuming in the short term. In the latter case, a possible source of external funding could be a third-party investor, such as a venture capitalist or business angel. Again, growth is likely to remain an imperative for the externally financed start-up as early-stage venture capitalists set ambitious growth objectives for their investee firms in order to maximise valuations and capital gain. Ven-

⁷ Note that the term 'entrepreneur' will be used to refer both to an individual founder/manager or a founding/management team of a start-up.

⁸ As the 'dominant design' literature shows (Anderson and Tushman 1990), superiority does not necessarily mean technologically more advanced as successes in the PC operating system and VCR tape markets bear witness.

ture capitalists also live in competitive markets. They must demonstrate attractive portfolio returns to their institutional investors if they wish to ensure the success of future fund raising exercises

Assuming growth is an imperative and that, in a European context, this growth may more efficiently be achieved through international expansion, what factors other than the entrepreneur's ability to operate in different cultural environments facilitate or hinder the establishment of cross-border activities? Is there an identifiable link between the strategic orientation of a new venture (for example, its pricing strategies), its choice of distribution channels or the specific characteristics of its products, and the firms' consequent success in establishing cross-border sales? Research studies have examined the relationship between the profitability of a start-up and various strategy variables (for example Feeser and Willard 1990, Picot, Laub and Schneider 1990, Carter, Stearns and Miller 1994). However, only one study (undertaken in the US) is known to the research team which tried to link strategy and product variables directly to internationalisation performance (McDougall 1989). It is illuminating, given European arguments of insufficient domestic market size, that this US study defined 'international' start-ups as firms with a minimum of 5% of their sales coming from cross-border operations. It is, therefore, debatable whether the findings of this study are widely applicable outside the US. This is particularly so as internationalisation did not feature as an area of primary strategic concern for the majority of the US companies which McDougall surveyed.

McDougall's American findings are in apparently stark contrast with the findings of a number of European researchers who have shown that it was not unusual for the NTBFs in their samples to have the majority of their revenues coming from abroad (Bell 1995, Nichols and Nyvold 1995, Jolly et al. 1992). However, because of the exploratory focus of these case study investigations (Yin 1994), their primary importance is in highlighting the very different market situations facing US and European NTBFs. In order to corroborate trans-Atlantic differences, further systematic research into the links between strategy variables and internationalisation performance would necessarily require substantial survey activity and the authority of statistical verification. The research team believed that, given these valuable 'straws in the wind' provided by the cited case study research, there was a strong case to be made for the execution of a major survey looking specifically at the contemporary internationalisation behaviour of NTBFs in Europe.

1.6 The Comparative Dimension: Germany versus the United Kingdom

An Anglo-German comparison has relevance and value because it can help shed light on three important issues. First, in the debates of international competitiveness, Germany is usually referred to as an example of a highly regulated country. Conversely, the UK is seen as a more deregulated economy in which the primacy of market forces is viewed as more important. A highly regulated environment is believed to be one consequence of a culture which is characterised by strong uncertainty avoidance (Hofstede 1980, 1991). Given the central role of uncertainty in behavioural theories of international business, German firms - irrespectively of their size and their sector of activities - should *inter alia* be generally less outward oriented than British start-ups. Second, the direction of outward trade flows of these two countries differs markedly. British companies have traditionally had closer economic (and cultural) ties to North America and to members of the British Commonwealth. While fellow members of the European Union are cumulatively the largest trading partner of the UK, the US continues to remain the critically most important market for British firms. Conversely, the majority of German exports are traditionally oriented towards its neighbouring countries in continental Europe with France being the largest single market worldwide (IMF Direction of Trade Statistics Yearbook 1998).

The US was perceived by many NTBF respondents as the single most important market for high-tech products. America arguably boasts the most sophisticated customers for high-technology products and services. This is of importance for NTBFs as many new product innovations are frequently triggered through close co-operation with lead customers. It therefore becomes of interest to find out whether the internationalisation activities of British and German NTBFs do reflect the traditional direction and patterns of these two countries' aggregate trade flows. Conversely, given the peculiarly super-national characteristics of technology products and their users, is there a convergence in UK and German new

technology trade flows? If the latter is true, it would reflect the greater strategic importance attributed by NTBFs to key contemporary markets for technology rather than to historic trading patterns and traditional partners.

There is a third issue that is of relevance for an Anglo-German comparison. The UK hosts the most vibrant NTBF sector in Europe (Storey and Tether 1998) with arguably the best provision of market mediated, finance and other support mechanisms (Murray 1995). Other scholars have argued that the way firms and markets operate is strongly influenced by the national institutional context (see Lane 1992 for an explicitly Anglo-German comparison). It has to be acknowledged that a detailed analysis of how the two different contexts shape the international activities of NTBFs is beyond the scope of the proposed project. Nonetheless, the debate on national business systems (Whitley 1992) and national innovation systems (Nelson 1992, Lundvall 1992, Legler, Licht and Spielkamp 1999) would benefit from research comparing the outward orientation of British and German NTBFs.

In summary, one would expect that British NTBFs are more outward oriented than their German counterparts. However, the example of traditional German SMEs, the "Mittelstand", shows that a large proportion of these firms is very actively involved in cross-border activities. The situation is more complex than simple, national characterisations might suggest. Therefore, an investigation which includes these issues could examine the question whether or not these firms behave according to national stereotypes. Conversely, it might be argued that there exists now an occupational 'high-tech' culture which transcends national borders. The latter hypothesis has been suggested by at least two recent exploratory studies which reported that the internationalisation processes of several NTBFs originating from different countries were very similar both in terms of structural aspects and 'triggers' (Boter and Holmquist 1996, Oviatt and McDougall 1994). As only one German and one British firm were included in one of these two studies, neither study adequately addresses our agenda. It therefore remains valuable to investigate on a larger scale whether one can observe more similarities than differences - and in what specific activities or functions - in the internationalisation behaviour of start-ups operating in these two distinctly different European business cultures

Overview

The following summary of our research findings are reported in three main chapters. We opted for a two-stage research process based on the methodologies employed. Econometric models were initially constructed to determine the key variables influencing each particular area of firm behaviour. In addition, the nature of the similarity or the difference between German and UK companies was noted on those occasions where the differences were statistically significant and deemed material. The findings of the quantitative analyses were also interpreted and referenced in the light of a parallel series of 40 case studies undertaken on a sub-sample of German and UK respondents from the postal survey. Again, a matched sample approach was adopted in order to highlight possibly important differences at the levels of the firm, market or product between internationalising and non-internationalising firms. The combination of the two research methodologies allowed the power of the statistical analyses to be directly complemented by the richness of detail and insight obtained from personal interview and discussion. The dialogues with selected firm founders, on which the case studies were based, were particularly useful in assisting both the interpretation of quantitative data and the discussions of policy implications stemming from our findings.

In this summary report we omit as far as possible the discussion of methodological details e.g. with regard to specific reasons for the exact definitions of variables or the detailed specification of regression models. In order to keep this summary report a manageable length, we also avoid lengthy discussions of the relation of our results to the existing literature or why we choose a certain type of econometric model. Further, we omit a case by case discussion of our 40 matched pair, case studies. However, a more detailed description of our research methods and findings is available in the full version of our report⁹.

⁹ In addition to this AGF Summary Report, it is the intention of the authors to produce a published volume of the full research report in 2001. Readers wishing for more information in the interim can approach Drs. Licht or Murray at ZEW or London Business School, respectively.

Chapter 2 which presents our findings using a quantitative methodology is organised as follows:

- We first summarise in *section 2.1* the process of data collection from the mail survey and give some brief observations on methodological aspects of the data collection process. This section gives details on the origin of our samples and some indication as to how we weight our data in order to arrive at meaningful descriptive statistics for NTBFs in both countries.
- Based on the mail survey data, *section 2.2* provides an overview of the importance of international business for young, high-tech companies. Descriptive statistics presented in this section convincingly demonstrates that international business is the rule for NTBFs and not the exception.
- *Section 2.3* presents descriptive details on UK and German NTBFs. This section enables a comparative UK-German perspective on characteristics of NTBFs and so allows comparisons between our study and other empirical studies of NTBFs. We provide information on firm-specific (e.g. age, industry, size) and founder-specific characteristics (e.g. international experience, team size) and describe the firms in terms of the degree of customisation and the technologies adopted in their main product. Some descriptive results on motives and costs of international business activities are also provided.
- The theoretical framework which guides our empirical analyses is summarised in *section 2.4*. Here we discuss briefly the main theoretical perspectives on the internationalisation of new technology based firms. We highlight the empirical implications of various theoretical approaches and discuss their empirical implementation within a multivariate regression framework.
- *Section 2.5* looks more closely at the *differences* between start-ups with and without international activities. We test the applicability and discriminatory power of various propositions derived from our theoretical framework. Thus, we attempt to explain why some start-ups engage in cross-border activities from an early stage of their existence whereas others only serve their home markets.
- *Section 2.6* introduces the empirical results with regard to the determinants of the *degree* of internationalisation of the sampled firms. This section addresses the question whether internationalisation could be interpreted as a non-linear phenomenon, i.e. the actions of internationalising firms can best be understood and modelled as “overcoming a barrier” or “jumping a threshold”.
- *Section 2.7* investigates issues related to the *timing* of internationalisation. The unexpected, early or accelerated foreign market entry and subsequent evolution of international activities is arguably one of the defining features of internationally operating start-up firms.
- *Section 2.8* summarises our results regarding the *entry decisions* of NTBFs. It describes the geographical and structural aspects of the market entries of the sampled firms and also investigates the determinants of the chosen entry modes.
- The impact of internationalisation on the performance of NTBFs is evaluated in *section 2.9*. First, we compare the *productivity* (sales per employees) of internationalisers and non internationalisers. Second, we look at the determinants of sales and employment growth and test for significant differences between firms with and without international sales.

Chapter 3 presents the results based on the matched pair case studies. It is divided into six sections and covers the following aspects:

- *Section 3.1* briefly describes the matching criteria used for both the UK and German cases. The data collection process is detailed. The different steps in summarising and analysing the match pairs studies are introduced and described in order to make the process of information retrieval from oral interviews transparent.
- *Section 3.2* sheds some more light on the timing of internationalisation by analysing the case study results. Especially, we discuss the role of MNCs for the internationalisation process of NTBFs.
- Similarly, *section 3.3* categorises the typical features of fast growing firms and slow growing firms. Our case studies confirm the crucial role technological advantages have for fast growing

German firms. In contrast, fast growing firms in the UK more strongly stress the importance of managerial experience or market strategies as the key drivers of growth.

- The role of venture capitalists, as a professional source of finance and advice, for the development of NTBFs is discussed in *section 3.4*. We discuss the complex relationship between entrepreneurs and their professional investors and – based on case study evidence – demonstrate the multi-faceted nature of venture capital investment.
- We also talked to the entrepreneurs about the role public support measures have in the process of firm formation and firm growth. Their views are reported and appraised in *section 3.5*.
- Finally, in *section 3.6* we seek to establish some robust differences between British and German NTBF. However, it transpires that, as evidenced from the case studies, NTBFs in Germany and Britain share a great deal in common, for example facing similar problems and develop similar strategies to deal with these problems. Where differences do occur, they are frequently a result of the differing education systems and variations in the existing industry structure.

Chapter 4 provides an overall summary of our work and highlights the key conclusions of the study. These conclusions are first used to develop a list of ‘strategic lessons’ for entrepreneurs and managers of NTBFs (*Section 4.1*). Conclusions and implications for innovation and technological policy are contained in *section 4.2*. In *section 4.3* we discuss existing theories of international entrepreneurship and give a summary evaluation of their empirical relevance from the perspective of our own findings. Finally, we suggest some future research directions for the important subject of international entrepreneurship

Appendices are also included (A to D) which provide additional information for the more technically interested reader detailing aspects of the research methodology used to conduct the study. Appendix D also contain descriptions of the full regression models from which the results discussed in this report are derived.

2 Research Findings from the Quantitative Methodologies

2.1 The New Technology Based Firm Mail Survey

Data for quantitative part of our study was generated through a mail survey using a four page questionnaire which was virtually identical for both countries. A copy of the questionnaire is given in the Appendix B. The questionnaire included variables to measure 'transaction costs' during the sales process and proxies for situation in which high transaction costs are expected to occur. In addition, information on the commercial and international experience of founders was requested. We also asked respondents several specific questions about the characteristics of their firm, including details of the traded products and services as well as the resources devoted to R&D. Finally, the respondents were asked to rank different motivations for international activities, and to determine the scale of costs and constraints which they had experienced during this process.

For the purpose of this study, a high-tech start-up is defined as being a legally independent company which is no older than ten years since formation and which operates in one or more high-technology sectors. We use the list of high-technology sectors established by Butchart (1987) to determine the relevant sectors in manufacturing. In addition, we include start-ups from selected service industries which were found to be R&D intensive in a recent study for Germany (Licht et al., 1997). One major drawback of our study is that we neglect high-start ups in low-tech industries. Yet, as opposed to targeting low-technology sectors in the search for high-technology start-ups, the adopted approach resulted in an increased likelihood of obtaining responses from firms that fulfil the specified sampling criteria for our mail survey. Details on the specific industries included in the survey are also given in Appendix 1.

We use sampling frames resulting from similar data sources in both countries. Sampling was based on firms operating in the defined, high tech industries, which had at least three employees in 1997, and that had been founded between 1987 and 1996. To identify those firms we used Dun & Bradstreet in the UK and Creditreform in Germany. These two firms are recognised as among the leading credit rating and business information agencies in both countries. All identified company records were subsequently screened to exclude those firms whose business activities suggested that they were not primarily engaged in producing and developing new products, services or processes. As a result, 2,671 firms in UK and 5,045 firms in Germany, respectively, were retained as eligible for inclusion in the research sample. In each country, we select a total of 2,000 firms for inclusion in the survey using a stratified random sampling process (i.e. stratified by size class and service/manufacturing categorisation).

The mail survey was started in October 1997. It resulted in 232 usable¹⁰ questionnaires for Germany and 362 for the UK. While there is a difference of response rates between the countries (24% of eligible firms in the UK; 14% in Germany), the response rates within the strata were distributed in a similar way. This common pattern suggested a low selectivity bias in the response behaviour of firms for both countries.

¹⁰ Researchers were meticulous in checking the validity of each respondent before including them in the final data set. For example, all management buy-outs or firms in high tech sectors but performing low tech activities, i.e. distribution, were removed from the accepted samples.

2.2 The Incidence of Internationalisation

The nascent firm is formed and subsequently evolves in an environment typically characterised by multiple sources of risk and uncertainty. The potency of the threat of such actual and potential predations is seen in the statistics that confirm that the majority of small and medium sized firms do not survive long enough to enjoy their 10th anniversary (Storey 1994a). In this context, the preparedness of young technology entrepreneurs to accept a major additional source of potential threat to their immature and vulnerable businesses by embarking on international sales is remarkable.

Therefore, our first (and arguably most important) finding is that *international activity is the norm for a majority of young technology based firms*.

Firms with a solely domestic market focus are the minority and over time become an increasing exception to the rule. This conclusion holds true for the NTBF populations of both Germany and the UK even after acknowledging that the data collection process is likely to have had a positive bias towards selecting internationalising firms.

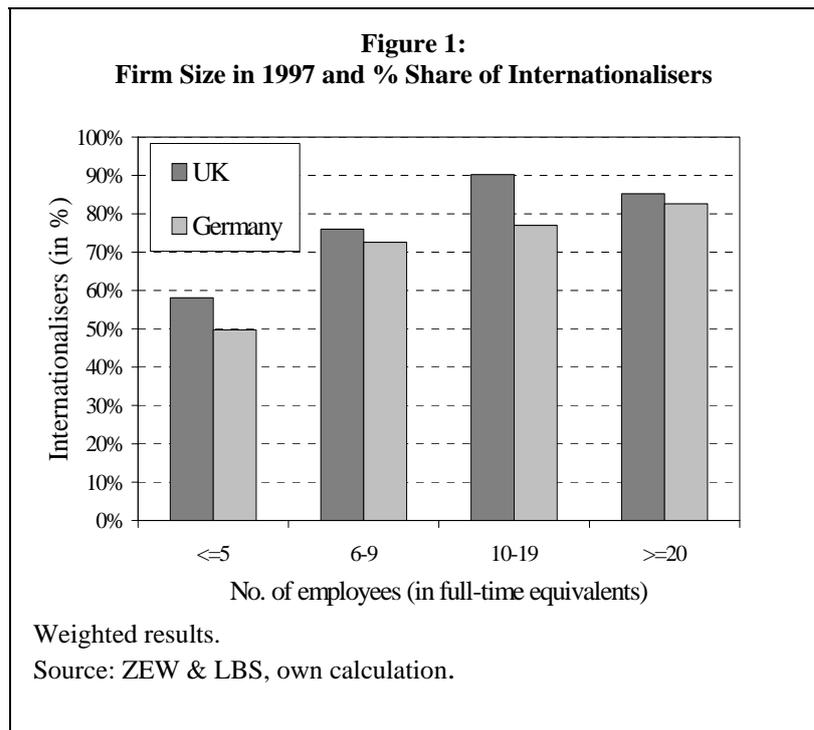


Table 2-1:
**The Percentage of Firms Internationalising
by Employment Size Category (in %)**

Country	Number of employees at start-up *				Total
	<=5	6-9	10-19	>=20	
UK	58.1	76.0	90.2	85.2	60.8
Germany	49.7	72.6	77.0	82.6	54.9
Total	52.9	73.5	79.3	83.4	57.0

Country	Number of employees in 1997*				Total
	<=5	6-9	10-19	>=20	
UK	52.0	51.7	65.2	76.1	60.5
Germany	34.5	58.4	65.1	63.4	54.6
Total	40.5	55.7	65.1	68.4	56.7

Weighted results; * full-time equivalents
Source: ZEW, WBS, own calculation.

quickly than their British counterparts. This may well be a reflection of the greater proximity of other neighbouring national markets enjoyed by continental European countries. None the less, over time, the export intensity of British firms (43%), when measured by the existence of international sales in at least three countries, was over twice that of German firms (21%). However, these broad statistics are better redefined and interpreted in the light of the characteristics of the firm, its management and its markets. These interpretations are developed below.

Indeed, researchers in both countries found the execution of a matched pair sampling frame required material effort to ensure the identification and involvement of an appropriate number of domestic-only, survey respondents, i.e. non internationalisers. In short, it was harder to find firms which had not internationalised than firms which had. Overall, just over half of our total sample (57%) had internationalised (Germany 55%, UK 60%) at the time of the survey. Moreover, they had internationalised very rapidly. One in five firms in our sample had started to sell abroad within the first year after start-up.

German firms internationalised more

Table 2-2:
International Activities of Firms

	Total Sample	UK	Germany
% of firms with international sales	56.7	60.4	54.6
Time lag between start-up and international sales (years)	1.84	2.22	1.63
Time lag between first domestic sales and international sales (years)	1.34	1.53	1.24
% of firms with international sales into at least three countries	29.0	43.3	21.2
% of firms that generating at least 10% of revenues through international sales	40.0	46.8	36.2
% of firms that generating at least 50% of revenues through international sales	14.8	22.7	10.4

Weighted results; Source: ZEW & LBS, LBS own calculation.

2.3 Key Characteristics of the Sampled Firms

Importance of Size

The vast majority of the sampled firms started small with over 80% having less than 5 FTE (full time equivalent) employees at start-up. They also remained small with only one fifth of all firms sampled in 1997 growing to reach a workforce greater than 20 FTE employees. The average and median sales turnovers for the start year and last year (1997) also indicate that the majority of new businesses remain relatively small throughout their lives.

The above figures Table 2-3 show that German

companies tend to have larger sales values in the year of formation. Thus, German enterprises start larger both in sales and employment terms.

However, over time the UK firms appear to catch up the earlier German lead. Given the above two tables deal with categorical distributions or aggregate statistics, they do not show individual data regarding the fastest growth companies. At the firm level, regardless of whichever criterion was used, i.e. employment or sales, the most rapidly growing companies were predominantly UK in origin. However, again caution is necessary. The survey was undertaken when German was still coming out of a major recession in the mid 1990s. The UK had lead most of continental Europe by entering and leaving this international recession more early than the other European states. Discrepancies in the means or medians may well reflect a lag effect in the economic cycles of the two countries. However, this explanation cannot deal with the predominance of UK companies among the most rapidly growing outliers.

As has been shown repeatedly in SME studies, it is only a minority of firms which metamorphose into substantial businesses. The fact that the majority of these NTBFs started *and remained* as micro-firms

Table 2-3:

Distribution of Firm Size at Start-up and in 1997 (in %)

Number of employees*	Start-up			1997		
	UK	Germany	Total	UK	Germany	Total
Less than 5	88.1	80.0	82.9	25.7	28.0	27.2
6-9	7.3	11.4	9.9	28.5	23.8	25.5
10-19	2.2	6.0	4.7	22.2	27.9	25.9
More than 20	2.4	2.7	2.6	23.6	20.3	21.5
Total	100.0	100.0	100.0	100.0	100.0	100.0

Weighted results; * full-time equivalents.

Source: ZEW & LBS, LBS own calculation.

Table 2-4:

**Size of Sample Firms in Revenue Figures
(excluding Firms Started after 1995)**

<i>ECUs</i>	Revenue in Year of First Sales		Revenue at Last Financial Year (1997)	
	UK	German	UK	German
Mean Revenues	362,585	417,124	1,685,584	1,690,141
Median Revenues	163,043	268,354	896,739	1,037,975

Source: ZEW & LBS, LBS own calculation.

(i.e. 10 workers or less) raises questions about the possibly low threshold of the ‘minimum efficient scale’ for a viable technology-based business. Conversely, it may be argued that NTBFs are obliged to start below an efficient size because of the problems of capital rationing. At start-up, German firms are slightly larger than their UK peers. However, this size difference erodes and even slightly reverses by 1997. Within the context of the research study’s focus, firm size is of great significance as it is clearly evident that it is positively associated with the degree of internationalisation. Three-quarters of all firms of 10 employees and above had, at the time of the survey, almost one quarter (23%) of their total sales revenues coming from foreign customers. The only exceptions to the general trend of a very high export orientation among NTBFs were the East German firms in the sample. For historical reasons, these firms were more domestically oriented. However, the figures also suggest that this more parochial but rational choice is likely to change over time as the competitive skills of these firms develop in line with their Western counterparts.

Industry Differences

There are some significant industry differences between the firms surveyed. Five aggregate sector classifications were used: software; ICT-hardware (information and communication technology); engineering; health (pharmaceuticals, medical equipment); and ‘Others’. However, with the general exception of soft-

ware/non-software distinctions, industry classification proved to be a less than useful variable for analysis. Industry classification appeared to act in a range of directions and helped to explain outcomes not explained by other variables. Yet, industrial classification did not prove to be a robust discriminator nor a consistently useful explanatory variable. For example, while software firms started relatively large in the UK, in Germany they were the smallest industry category at start-up. Software firms were essentially more likely to be customised in their relationships to users and clients. This had the consequence of limiting the internationalisation capabilities of this industrial category. However, the researchers were impressed by how many software and service based firms had internationalised.

There were also, as expected, notable country/industry interactions. For example, when measured by relative annualised growth rates, German engineering firms excelled as did British ICT-hardware firms. Both sector and country differences persist when firms are assessed by their share of international sales. Software firms remain much more local than either ICT-hardware or health sector firms. This is true for both Germany and the UK. However, British high tech, young firms are typically more international across all sectors.

Table 2-5:
Start-up Size, Size in 1997 and Average Annual Growth Rates by Industry

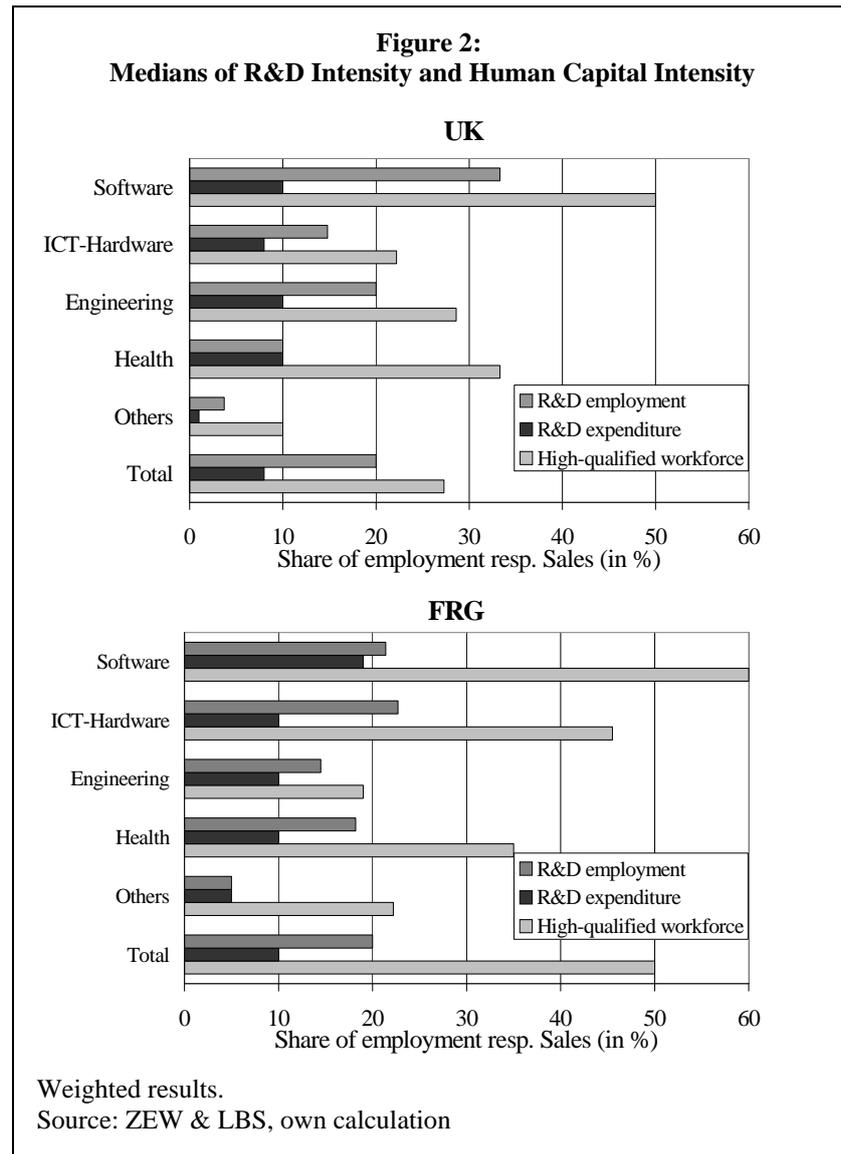
Industry	Average number of employees at start-up*		Average number of employees in 1997*		Average annual growth rate (in %)	
	UK	Germany	UK	Germany	UK	Germany
Software	4.0	3.7	16.1	13.3	22.5	22.1
ICT-Hardware	3.0	5.1	17.3	14.9	25.5	18.3
Engineering	3.1	3.9	11.7	13.7	22.4	26.4
Health.	4.2	5.6	17.6	17.9	22.7	24.1
Other	4.7	7.7	16.7	19.6	22.5	18.0

Weighted results; * full-time equivalents.

Source: ZEW & LBS, own calculation.

R&D Investment

Sector and country differences persist when measuring the knowledge base of the respondent firms. What is immediately evident is that these young firms are almost invariably characterised by extremely high R&D investments when defined by either R&D expenses as a percentage of total sales, R&D employment as a percentage of total workforce, or the percentage of the workforce holding university degrees. While UK firms appear to engage more frequently in R&D activities, individual German firms, when they do undertake R&D, tend to invest more resources in this activity. For the 88% of UK and 79% of German respondents which under-take R&D, these firms are nearly twice as likely to conduct research activities on a permanent rather than an occasional basis. Thus, they demonstrate a very real commitment to knowledge accumulation despite the scarcity and cost of resources for the micro or small firm. It can be demonstrated that it is the *permanence* of the R&D activity that is important for internationalisation activity. Approximately 70% of firms undertaking permanent R&D also have international sales. The incidence of internationalisation drops to under 50% of sampled firms when they undertake only occasional or no R&D activity.



Management Characteristics

The analyses indicated the importance of the previous professional experience/human capital of the managers who had founded the NTBFs. Founder specific characteristics are particularly important in determining and predicting the likelihood of the firm internationalising. Over 60% of all firms are started with one or two founder members. German entrepreneurs have a greater preference than their UK counterparts for starting enterprises with a larger management team of four to six persons. This is partly a reflection of the larger number of software companies started in Germany.

There was a very high incidence in both countries of managers having worked together prior to starting the current (surveyed) business. This common history increases the chances of the firm having international sales. This direct effect is however, significantly smaller than the effect of previous work experience. When a firm is founded by managers who have previously worked abroad or who have been employed by an international firm, there is a very marked increase in the propensity to internationalise. This is particularly the case with British firms. Interestingly, if a respondent was educated

abroad, this event had a notably less powerful impact on influencing the firm's subsequent international behaviour. It is perhaps surprising, given the relatively isolated location of the UK, that UK managers were frequently more international in perspective than their German counterparts. This situation pertains despite the higher export intensity of the German economy when compared to the UK especially in high technology goods.

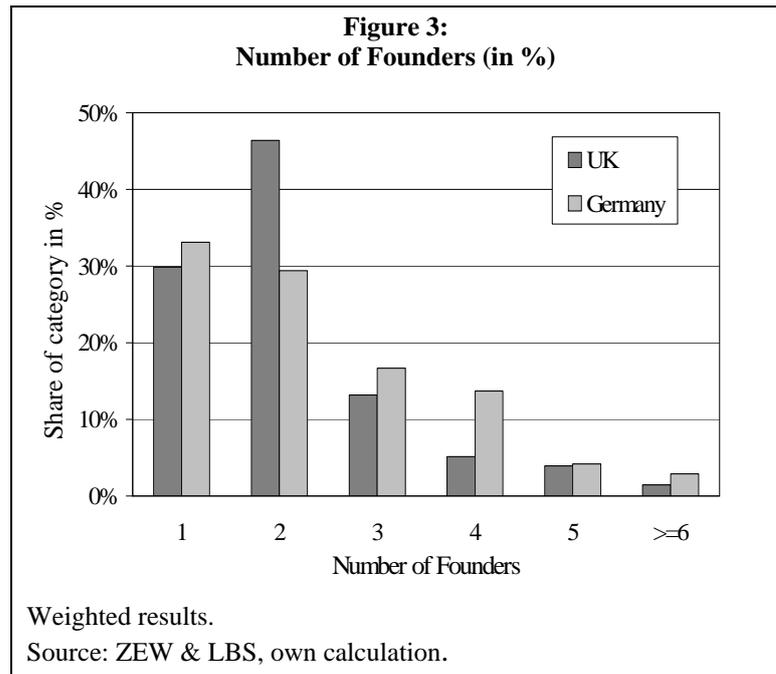
The data suggest different sets of relationships between large and small firms in Germany and the UK. In Germany, there is a predominance of German owned and domiciled firms that sell strongly to Western and Eastern Europe. Conversely, in the

UK there are fewer large UK owned and domiciled firms to act as customers for UK high tech young firms. There is, however, in the UK a significantly greater presence of foreign owned, multinational firms with regional headquarters or major installations sited in the UK. These two different environments each worked to produce clearly different effects. German small high tech firms focused their strongest selling activities on large, domestic German firms. Frequently, exports were gained as a result of the German customer requiring the supplying small firm also to service additional facilities in neighbouring countries. Thus, initial domestic sales in Germany would lead to additional export sales for German companies - typically in Austria, the Netherlands and France. This behaviour appeared to the researchers to be like a 'convoy' of small German firms surrounding and servicing a smaller number of major German enterprises. The distinct impression was gained that German entrepreneurs, if given a choice, preferred to sell to large German firms in their domestic market. If expanding markets generated foreign sales opportunities, the preference for these entrepreneurs would remain the selling of products and services to foreign subsidiaries of large German firms. This need to manage uncertainty by selling to long term customers from the same cultural grouping strongly corroborates behavioural theories of internationalisation particularly the concept of 'psychic distance'.

In contrast, the significant inward migration of multi-national companies to Britain has obliged small UK firms to become much more international in both customer focus and in the career histories of their employees. The UK economy is smaller and there is a lesser number of substantial UK owned firms compared to the situation facing small German firms. UK managers have less choice than their German counterparts other than to be more international in outlook even when dealing with domestic sales. This relatively greater international perspective of UK managers is evidenced in both a greater incidence of work experience with multi-national companies and/or work experience abroad. If British managers' experience is, in part, linked to the UK's popularity as a location for inward migrating firms from Asia and North America, this greater familiarity with diverse economies would help to explain the greater compass of UK international activities compared to German export behaviour.

Lack of Managerial Skills

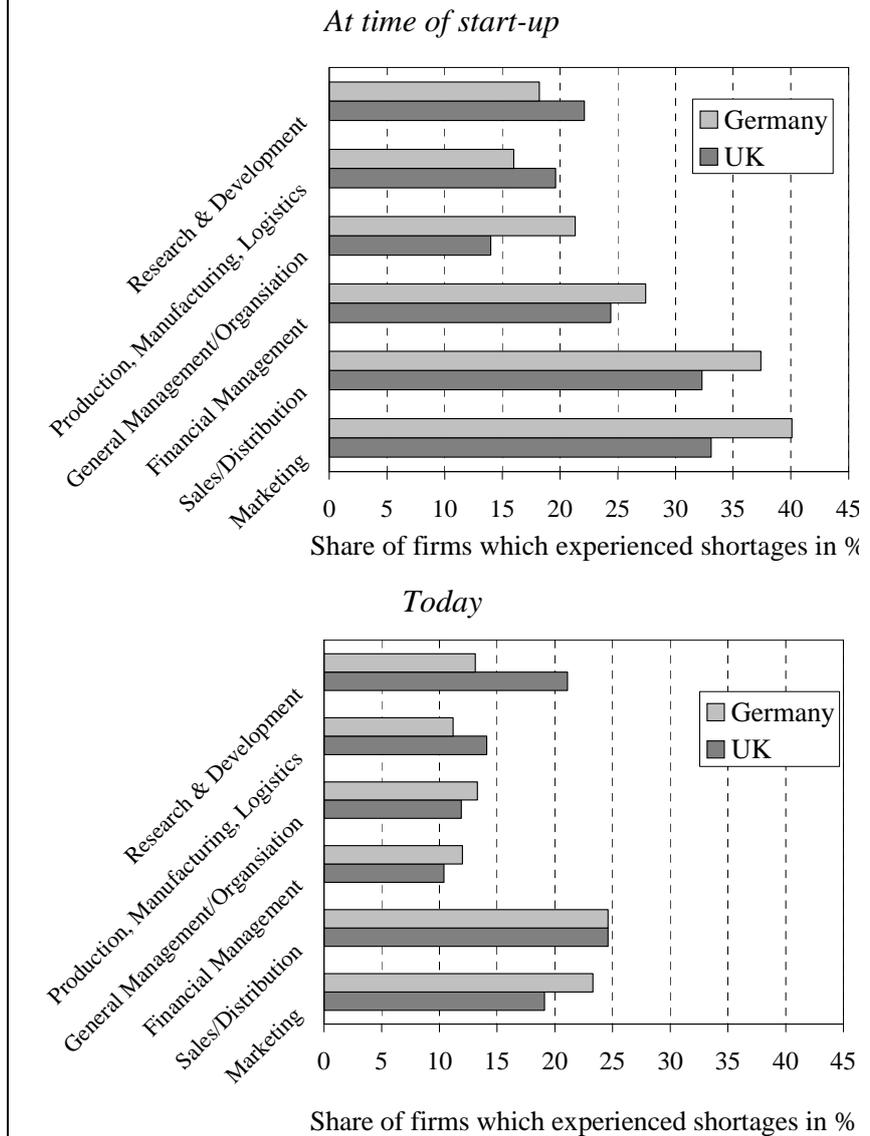
The respondents were asked to determine the nature and the degree of skill shortages faced by their companies both at start-up and at the time of the survey. The German firms reported relatively greater weaknesses in the managerial skills of finance, sales, marketing and distribution. For the UK firms, relative weaknesses were more evident in R&D and production capabilities. The explicit nature of these different constraints reflects stereotypical views of the two countries' sources of comparative advantage. Over time, the German firms managed to reduce the skill shortage gap, both absolutely



and in relation to the UK firms. Conversely, the R&D shortages, while remaining constant in absolute terms for the British, increased relative to their German competitors. Transition matrices indicate that UK and German firms differed in their ability to resolve initial resource weaknesses.

The UK firms appeared less successful than their German counterparts in correcting infrastructure weaknesses over time. This relative weakness of UK firms in comparison to German firms may reflect the different nature of scarce inputs in the two countries. In small firms, both managers and the general workforce typically 'learn by doing' rather than by having specific training. This experiential learning may be sufficient for employees to cope with generalised managerial duties - albeit more inefficiently than if specifically trained for the task. However, such a resolution of labour scarcity is much less feasible if the task is of a highly specific and technical nature requiring specific training and detailed instruction. German managers are more likely to be trained as engineers or in one of several technical disciplines. The pre-eminence given to scientific training is a long standing cultural trait in Germany. Such managers can more easily 'learn by doing' generic managerial tasks including marketing and sales activities. The same is not true of a salesman or production worker attempting to learn the necessarily precise technical skills of R&D activity. Thus, the skill base and the training infrastructure of Germany is likely to be able to allow small high tech firms to address their specific skill shortages more resolutely and quickly than their UK counterparts.

Figure 4:
Existence of Skill Shortages over Time



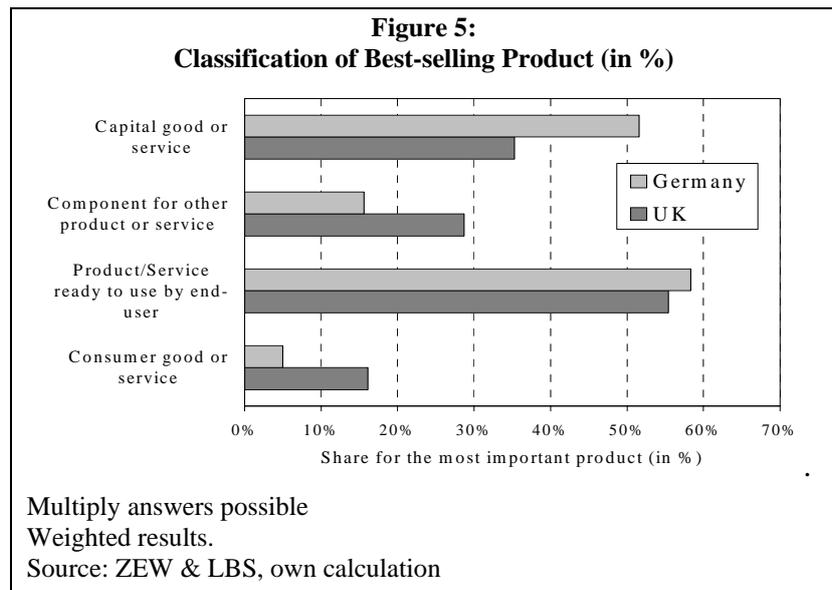
Weighted results.
nb. Only figures for 'strongly' indicated shortages of skills are presented.
Source: ZEW & LBS, own calculations

Product Characteristics

The products produced by both the German and UK respondent firms were primarily for industrial consumption either as capital goods or as components. Even those products sold ready for use were still targeted at industrial customers. Only 5% of German firms and 16% of UK firms produced products or services specifically for sale to the (non-industrial) consumer.

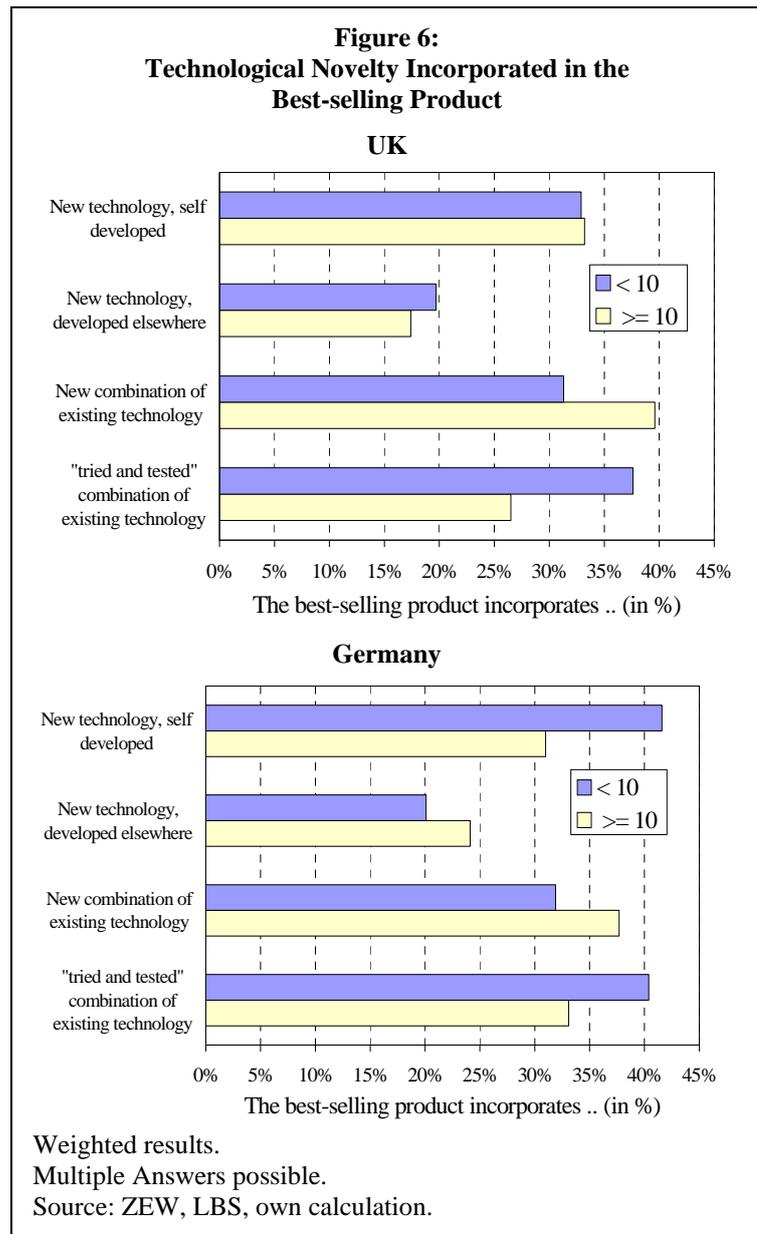
This industrial focus has major implications for the strategies adopted and the resources needed to market, sell and distribute their products and services successfully. The surveyed firms were specifically asked about the characteristics of their best selling products. It was evident that the firms expended a great deal of resources on the specific design of their products, and to supporting point of sale and post sale activities. This commitment of resources has both positive and negative consequences for the growth and internationalisation of the firm.

The provision of prior technical consultation, customisation of products to individual clients, training of sales staff, upgrading of products and specific configuration to the client's systems etc. allows the young firms to differentiate themselves from other and often bigger competitors. The most common marketing strategy is as a 'niche player' and the comprehensive client services offered can allow novel niche positions to be created and successfully defended. However, these services are highly expensive for the young and, as yet, unestablished firm to provide. The consequent large transaction costs are likely to reduce the firm's opportunity to internationalise. These effects are also likely to vary between industry and target market.



The Innovativeness of Products

In order to sell successfully into foreign markets, the exporting firm needs to be able to demonstrate some particular source(s) of competitive advantage. The research sought to determine to what extent the technical innovativeness of the products or services sold by the firm is a major element of such a strategy. The respondents were given a range of options to define the innovativeness of the technology which they incorporated in their products and services - from 'tried and tested combinations of existing technology' to 'new technology, self developed'. Both UK and German firms demonstrated broadly similar patterns of technology adoption. For example, the specific technology acquisition strategy of 'new technologies developed elsewhere' was unpopular in both Germany and the UK. This unpopularity was similar for all respondents regardless of firm size or nationality. What was striking was the firms' willingness to develop their own technology or to experiment with new combinations of existing technology. Micro firms with under 10 FTE employees were particularly innovative especially in Germany. These findings support one of the key attributes of NTBFs, namely their ability to create innovative products and services despite often operating under severe resource constraints (Acs and Audretsch 1990). Likewise, this also reflects the strategic importance of technology backed market niches for NTBFs.



Lead Times and Competitor Response

Technology markets are typically characterised by high levels of competition and inter-firm rivalry. Niche strategies are one means by which young firms may seek to attenuate the level of competition they face during the vulnerable, early growth period. The researchers sought to understand the period of monopolistic advantage during which a firm may extract super-normal profits and thereby attempt to recoup sufficient rents both to reward investors and to finance a next generation of products and services. The research findings indicated the high level of market contestability in the commercial environments in which these micro firms exist. A majority of firms did not expect more than 12 months' lead time over competitors. Over 80% of all surveyed firms saw this period of calm being less than 24 months. German firms were slightly more confident that they would enjoy more than one year's grace compared to their UK counterparts. The majority (60%) of these UK respondents saw their lead time being up to 12 months but not longer. This German confidence may reflect one advantage of greater specialisation, namely a higher level of short run protection. It may also be the case that a close, inte-

grated relationship to large customers (i.e. big manufacturing firms) and their stronger focus on investment goods helps German NTBFs to defend their market niches more easily. Conversely, it may suggest that rivalry in German markets remain less fierce than in the UK for these chosen sectors. Importantly, firms that conduct permanent R&D are likely to gain a 50% longer period of reduced competition when compared to their peers that undertake only occasional or no R&D investments. This finding is true for both countries.

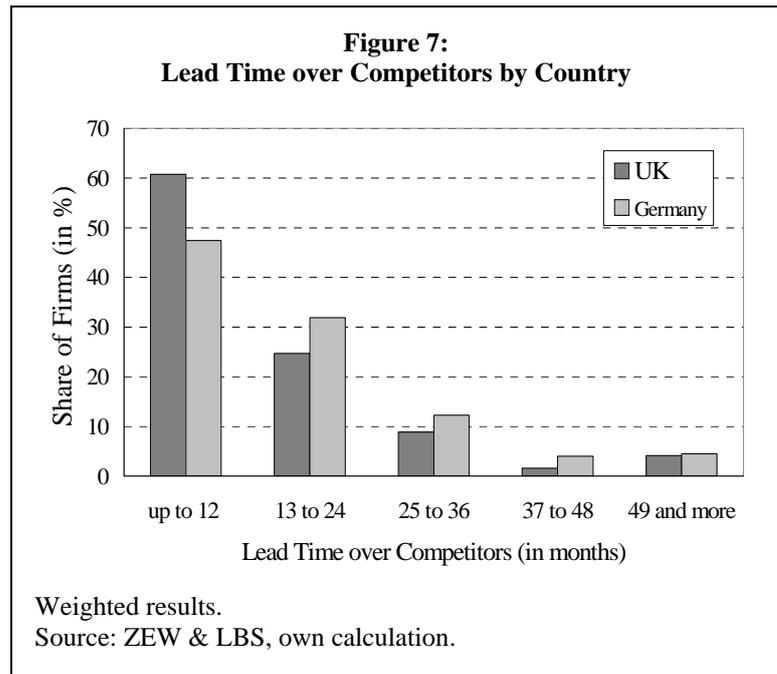
However, analysis shows that the concept of lead time interacts with market size. Larger markets tend to be characterised by more competitors, higher strategic stakes and more rapid competitive responses to new entrants.

A more truncated lead time is also associated with companies which grow faster, and have the opportunity to do so in these larger markets. This brevity of the lead time and thus market opportunity is a more significant factor than access to international markets as an explanation of rapid growth. The imminent arrival of competitors is a catalyst for the rapid exploitation of the transient economic advantage for the first incumbent in a market. Competitive economies create firms which grow more rapidly.

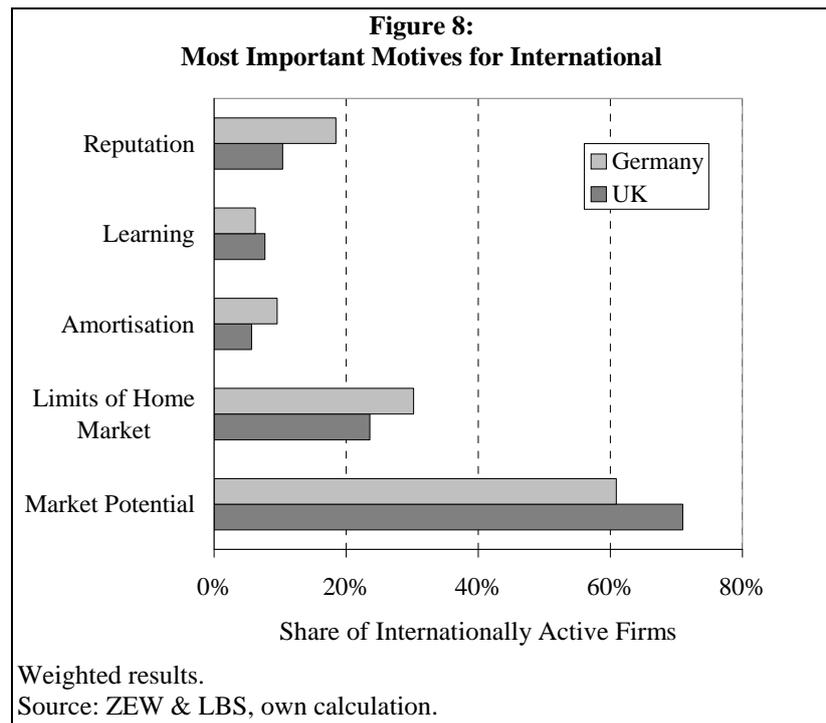
Where the UK and German high tech young firms differ is in the relationship between internationalisation and lead time. In the UK, this period of opportunity or respite from competition is smaller for internationally active firms. The opposite is true for Germany. The UK experience would suggest that internationalisation is a response to competitive threat and the vulnerability of remaining exclusively in one, highly contested, home market. In Germany, technology based market niches in the home market seems to be a prerequisite for international expansion. This again is in line with the observation that internationalisation of sales is part of a pro-active marketing strategy of the British firms whereas German firms often enter international markets as a response to customer's demand.

Motivation for Internationalisation

There are a number of both competing and complementary explanations as to why young and small firms would assume the uncertainties and risks of internationalisation. Demand based arguments focus on the limited capacity of the domestic market to absorb the existing and future production of the growing firms. Issues of limited lead time or the short technology trajectory are also demand based rationalisations for seeking to maximise the revenues available from international sales while the product still has a technological or related advantage. The attraction of the US market, particularly for technology firms, may be explained as a 'signalling or reputation effect'. What is signalled is the excellence of a product which can survive and flourish not just in the firm's domestic market but also in the single most sophisticated and demanding market for high tech products and services in the world.



The respondents were given a range of five choices to best explain their internationalisation activities. The additional sales revenue potential of foreign markets was the single most common explanation, accounting for over 60% of all responses. This was followed by the limitations of the home market. This was a response offered by around a quarter of all firms. This latter response would suggest that firms are not only 'pulled' by the advantages of additional sales revenue from internationalisation but that they are also 'pushed' beyond their domestic market by the limitations of its size. It is worth noting that Germany is the single largest economy in the European Union. Yet, 30% of the German respondents still saw this economy as being too small to fulfil their sales ambitions. Compared to these two dominant justifications, reputation, learning and amortisation of sunk costs remain relatively trivial responses at under 10% each for all firms.



The single exception is that 18% of German firm respondents did value reputation as an important motive. This latter finding may be explained as a traditional signalling effect among German firms and the German public. With the exception of only three years in the period post 1950, Germany has always run an annual trade surplus. Export activity is closely associated in the minds of industry observers and the German public as a highly desirable and laudable activity. Firms that have significant export sales are deemed to produce products and services of international competitiveness, i.e. outputs of high quality.

Strategic Commitment to Internationalisation

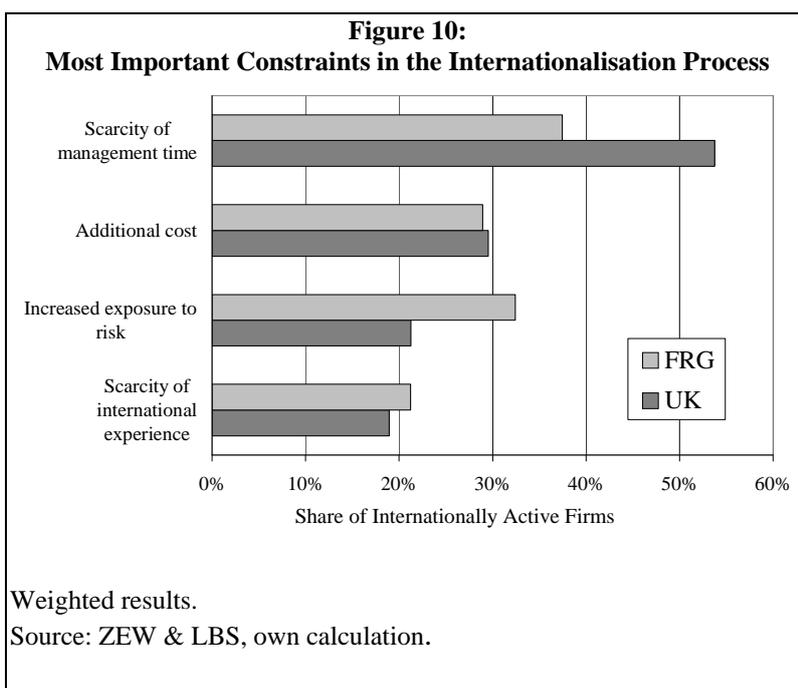
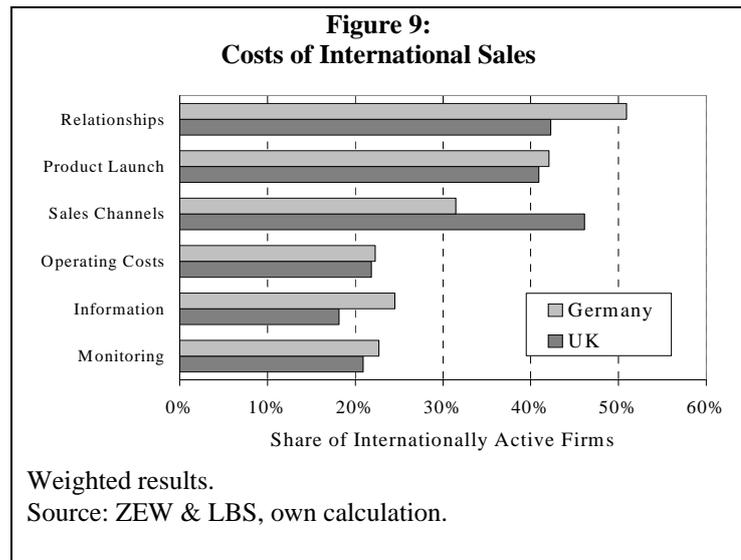
Whether or not firms are pushed or pulled actively into international markets, the evidence is that it is not an ill considered or serendipitous activity for the majority of firms. Over half of UK (65%) and German (53%) firms had made a commitment to international sales in their business plans *before* they had actually embarked on foreign sales. Health sector firms in both countries were most likely to have a prior commitment to internationalisation and ICT-hardware firms had the least prior commitment. However, these effects are less marked in Germany where less firms made *ex ante* commitments. Also statistically significant in the UK but not in Germany were the findings that firm size and the existence of an R&D activity were both positively associated with a prior commitment to internationalisation. However, it should be noted that 35% of firms did not have internationalisation plans and yet still internationalised in practice. Thus, the indicative strength of prior commitments should be viewed with some circumspection. In reality, for many respondents, internationalisation is a somewhat arbitrary and random process regardless of the existence or absence of formal plans. The uncertainty endemic to this process inevitably incurs costs and wasted resources. Thus, there may be a supportable argument for greater state assistance as a means of attenuating these costs, and thus the barriers, of early internationalisation.

Costs and Constraints of Entering Foreign Markets

When a firm embarks on international sales, it incurs a range of additional costs primarily related to country specific adaptations. These costs are not necessarily proportional to the scale of the foreign activity. They are frequently 'sunk', i.e. irreversible. For example, the cost of translating sales and operator manuals into a foreign language is not dependent on the number of sales subsequently made. Indeed, a large proportion of the total cost has frequently to be committed before any revenue is generated. If the firm later pulls out of the market or discontinues the described product, there is no residual value in the material. The burden of

these additional costs would suggest young and small firms would not, or should not, internationalise until they are larger, better resourced and more established. Our findings show that, however plausible this premise, it is not the reality for NTBFs in either Germany or the UK. Internationalisation in the norm for a majority of young firms and is undertaken very early in their life cycle. These decisions appear to be made despite of the additional costs incurred.

The actual nature of the costs of internationalisation incurred seems to be similar across the two countries. Building up relationships, product launch activities and investing in sales distribution channels were judged by the majority of respondents to be the biggest sources of costs. Germans were more focused on the cost of relationships while the British were relatively more concerned at the expense of building sales channels. This difference may well reflect the more bespoke or customised focus of the products and services of German firms in addition to their different geographies. Given this product/market strategy, ensuring the closeness of customer contact becomes an imperative. Conversely, for the more standardised products of the British respondents, creating efficient trade channels is a greater priority. When it came to describing the constraints which firms had experienced in undertaking international activities, respondents noted the additional country-specific costs and risks, in addition to the difficulties stemming from their limited, personal experience of international activities. However, the most important constraint was seen as the scarcity of (existing) management time and the additional demands that internationalisation would make on key executive staff. With firms continuing to experience shortages in sales, distribution and marketing resources, this concern is not unexpected. Just as the German firms were relatively more pre-occupied with issues of risk, the UK firms were particularly concerned at the problem of scarce management time. This finding is consistent with the fact that UK firms tend to start with



smaller management teams than their German peers, and that they also appear to operate in a less responsive, domestic labour market than the German firms.

Summary Descriptive Statistics

A summary of the descriptive statistics of the surveyed companies is given in Table 2-6. What is immediately noteworthy in this summary table is that firm/founder/product differences are frequently more evident between internationalising and non-internationalising firms, which may be of either nationality, than between German and UK firms *per se*. This leads us to believe that there are strong influences which impact on the manner in which firms behave once they start to sell in international, technology focused marketplaces. These operational influences appear more powerful than the national characteristics which initially define and separate young German or UK firms. To transpose the terminology from a different debate, 'nurture' appears more influential than 'nature'. However, descriptive data were not sufficient to answer the research questions set by either practice or theory. Thus, the survey data were subjected to a series of multivariate analyses structured around the major research themes of the *incidence*, the *degree*, the *speed*, and the *impact* of internationalisation activities.

**Table 2-6:
Summary Statistics**

	UK Firms	German Firms	Firms with International Sales	Firms without International Sales
<i>Firm characteristics:</i>				
International Sales (%)	60.0	55.0		
West German Firm (%)		40.8		
East German Firm (%)		14.2		
Employment at start-up (FTEs)	3.8	4.6	5.1	3.3
Employment in 1998 (FTEs)	15.8	14.7	17.5	11.9
Age of the Firm (1999)	6.4	5.8	6.5	5.4
Venture Capital Backed (%)	8.9	8.8	11.2	5.7
Public Grants Recipient (%)	13.6	21.2	20.3	16.2
<i>Founder Characteristics:</i>				
Work experience abroad (%)	51.4	29.7	44.0	29.0
Work experience in MNC (%)	46.2	37.4	48.0	30.7
Education abroad (%)	12.9	15.5	16.1	12.6
Number of Founders (%):				
- 2-3	45.7	28.8	28.6	43.1
- 3-4	18.1	29.8	29.4	20.6
- 5 and more	5.3	6.9	7.6	4.8
<i>R&D Activities:</i>				
R&D employment share (%)	26.1	27.0	28.0	25.0
R&D performed occasionally (%)	28.8	33.1	25.2	40.1
R&D performed permanently (%)	56.8	45.7	61.4	34.3
<i>Product Characteristics:</i>				
Degree of Customisation (%)	32.8	29.4	27.7	34.3
Age of Product (years)	4.9	4.8	5.2	4.4
Share of best selling product (%)				
- 30-60%	34.6	34.9	38.8	29.5
- 60-80%	31.0	39.8	28.0	48.0
- 80-100%	15.4	12.5	16.8	09.2
Capital good (%)	34.4	51.6	49.7	38.3
Intermediate good / service (%)	28.7	15.6	21.0	20.3
Window of opportunity				
Larger than 1 year (%)	52.6	60.3	64.7	48.2

2.4 Framework for Multivariate Analyses: Dimensions of Internationalisation

Ascertaining whether or not a particular firm or group of firms has internationalised has rather limited utility. In addition to the occurrence of internationalisation, other factors such as the degree and timing of internationalisation add valuable additional information. Thus, the research attempted to measure and understand the processes of internationalisation through several different, albeit related, lenses. Above all, the various dimensions of internationalisation were finally assessed in terms of their effects on a series of performance variables.

- As a first dimension we look at the **occurrence of internationalisation**. One possible measure of internationalisation could classify firms as “international” as soon as they have entered one foreign market or generated one percent of their total revenue through international sales during their last financial year. This operationalisation undoubtedly includes many firms that only had a few unsolicited orders from abroad and do not pro-actively internationalise. We therefore introduce two cut-offs to operationalise the somewhat fuzzy notion of “substantial” international activities. We therefore choose a threshold of 10% non-domestic revenue. The second cut-off criterion includes only firms that have entered at least three foreign markets at the time of the survey.
- There is considerable debate in the literature about the appropriate definition of the **degree of internationalisation** of a firm (see Sullivan 1994, Reuber and Fischer 1997). The literature convincingly demonstrates that internationalisation is a multidimensional construct and is not fully captured using a single measure such as the share of non-domestic revenue. However, in the absence of a preferable measure, we use the share of non-domestic revenues as the key measure of the degree of internationalisation.
- The **timing of foreign market entry** has received relatively minor attention from researchers. One reason might be the lack of adequate data when using samples of established firms. However, start-ups should represent an ideal test bed for exploring issues related to the timing of the initiation of foreign entry modes. The dependent variable for this analysis will be the time lag between the first sales of the firm and the first international sales.

Note that these three dimensions, occurrence to internationalise, degree of internationalisation and timing of internationalisation are closely related. The first dimension treats internationalisation as a binary choice of the firm. The second explores whether internationalisation is a continuous phenomenon, i.e. whether the same factors that discriminate between international start-ups and domestic start-ups also explain the variation of different levels or degrees of international activities. The third can be seen as an extension of the first dimension in a more dynamic context.

- A further dimension of internationalisation, the **choice of market entry mode**, is also investigated. As discussed above, the contradictions of different international business theories when applied to firms that are young and high-tech become particularly clear when looking at the choice of entry mode.

Finally, we will look at two indicators, the productivity and the growth of the firm, in order to assess the **impact that internationalisation has on firm performance**. When analysing productivity growth we use the standard Cobb-Douglas production function framework which is augmented by the internationalisation status and a number of other productivity enhancing factors. The growth of the firm is measured in terms of average annual change in sales between the first full business year and the most recent year for which data are available. Likewise, we define employment growth as the average annual growth of employment between the time of the survey and start-up.

Determinants of Internationalisation

In constructing our research questions, we believed that the various dimensions of internationalisation are expected to be a function of firm size, international experience of the founders, external finance, technology intensity, innovativeness of the product or service, the extent to which products are customised, and the costs of commercialisation. Accordingly, these factors were defined and operational-

ised with reference to extant literature in order to generate the necessary information via our data gathering.

Both the age of the firm, and its size have in the past been used as operationalisations of stage theories. Furthermore, the international experience is used to explain the entry mode choice. Also within a behaviouralist tradition is the use of the management's international experience as a substitute for the direct international experience of the firm. The variables derived from a transaction cost perspective are those metrics which determine the product-specific costs of commercialisation. Technology intensity has also been used in the past to operationalise situations character-

ised by high levels of uncertainty and asset specificity both of which give rise to transaction costs. The variables concerning management's skills and experiences, external equity and the innovativeness of the technology embodied in the products represent firm-specific assets that are imperfectly imitable and can therefore be seen as operationalisations of the resource-based framework.

The highlighted theories and their influence on dimensions of internationalisation and firm performance are graphically summarised in Figure 11.

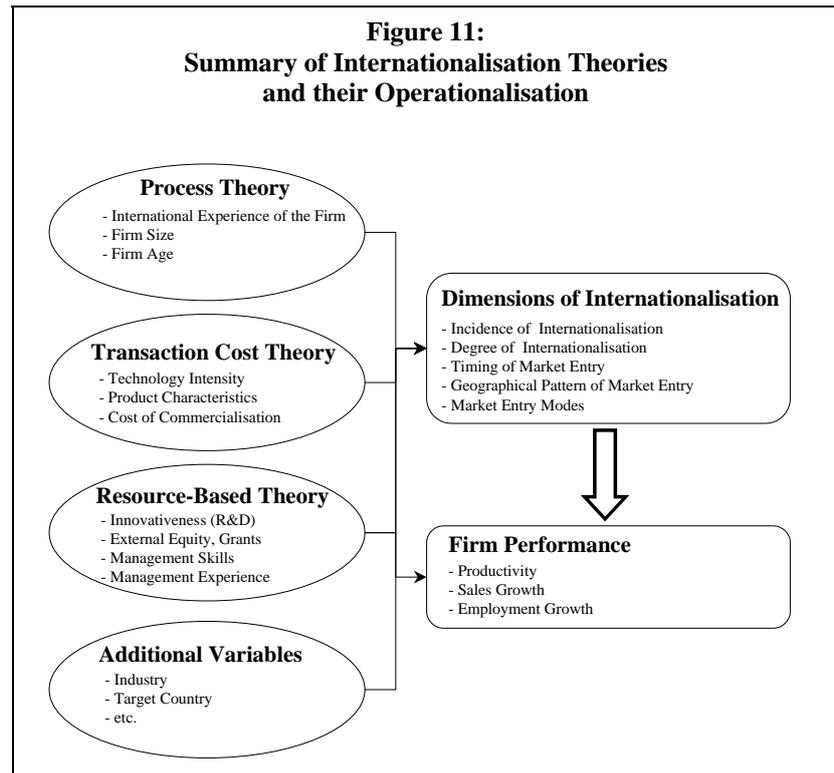
Firm size is operationalised as log values of the number of employees or sales. Since the actual firm size at the time of the survey could at the same time represent the cause and effect of international activities, we primarily used size *at start-up* in our regressions in order to avoid possible effects of endogeneity in the models.

International work experience was operationalised by asking the respondents in the questionnaire whether they had previously lived abroad, whether they had work experience with an internationally operating firm and/or whether they were educated abroad. The respondent's answers to all three questions have then been included as dummy variables in the models.

In accordance with standard practice (e.g. Butchart 1987, OECD 1997), we chose two indicators to measure **technology intensity**. We asked respondents to state technology intensity measuring i) R&D expenditure as percentage of total turnover and ii) R&D employees as share of total firm employment. In addition, the innovativeness of the technology employed was measured using a four-item scale. Respondents were asked whether their products were best classified as "incorporating tried and tested combinations of existing technology", "new combinations of existing technology", "novel technology developed externally" or "novel technology developed specifically for this product by the company".

The extent to which a product requires **client-specific customisation** and the **transaction costs incurred during the sales process** were each measured using a 5 point Likert scale. The four items measuring transaction costs (pre-sales consulting intensity, installation intensity, maintenance intensity, training intensity) were then combined into a single item.

Dummy variables have also been coded to indicate **industry affiliation**. We distinguish five industry groups. The grouping of industries is primarily determined by the similarity of the nature of competition and the dominant form of customer relations and not by the similarity of technical production processes (see Table A-1 for details).



The involvement of **venture capitalists, business angels and public grants** is simply captured by a dummy variable taking the value ‘one’ if those methods of financing are present at start-up or at the time of the survey. The degree of financial involvement (i.e. ownership) by venture capitalists or business angels in the respondent firms turned out to be problematic because the extent of their involvement was interpreted by respondents in different ways. The different understanding of these terms was particularly evident between German and UK firms.

Finally, we regard **macroeconomic influences** as potentially important determinants of the firm’s approach to international sales. Therefore, we integrated data on traditional, country-specific trade flows obtained for EUROSTAT as well as country GDP and risk data which were obtained from the IMF’s *World Investment Report* and the publication *Institutional Investor*.

2.5 Occurrence of Internationalisation

A Simple Comparison

As noted, the above statistics are descriptive rather than analytical in nature. However, they can act as a precursor to more powerful modes of statistical interrogation of the data. One of the most important innovations in the methodology of this research project is that it employs ‘matched samples’ across a large number of firms. Thus, we are able to compare respondent firms which are *similar* in size, age, sector etc. but are *different* in that one firm has international sales and the matched firm has only domestic sales. Using Probit regression and its more sophisticated variant, multinomial logit regression, we are able to use the binary or ‘n’ states, respectively, of the dependent variable (or outcome) to investigate the influence of independent variables of interest. For example, the Probit model is used to determine the direction of influence and the significance of a number of variables on the binomial choice, i.e. to internationalise or not to internationalise.

The Probit model was run as a multivariate analysis which encompassed country, firm and product specific variables (see Table D-1). These variables had been identified from theoretical literature, and from the pilot interviews undertaken prior to the main survey. The model was run on both the combined data and the German and UK data separately. In all three cases, the model allowed over 75% accuracy of classification. Thus, this model, describing the differences of internationalisers and non-internationalisers, was one of the most robust outcomes of the study. ***It can be used with considerable accuracy to predict whether or not a firm is likely to embark on international sales activity.***

The results for the combined Anglo-German sample indicate that the following factors *significantly increased* the probability of a firm internationalising:

- The firm is West German or British in origin (i.e. not from the former East Germany)
- The firm is in any industry apart from software and IT services (only relevant for ‘Other’ products in Germany)
- The firm is older
- The firm is larger (measured in terms of the number of FTE employees at start-up)
- The firm has a higher level of R&D intensity as measured by sales turnover (only significant for UK firms)
- The firm’s management has both experience in working abroad and/or has worked for a multinational company
- The product embraces novel technology (only significant for UK firms)

Some product characteristics - however only statistically significant for UK firms - *impede* the opportunities to internationalise. These are:

1. The product is ‘highly customised’
2. The product is a ‘consumer good’

3. The product is an ‘end-product’

These results suggest that the ‘archetype’ internationalising NTBF is highly sophisticated. It is larger and older than its peers. It is producing specialist products across a range of related industries for demanding industrial users. In order to produce these products, the firm invests intensively in R&D and encourages the use of novel technologies taken either from its own or other industries. These products are not customised, one-off designs for one or a few customers but incorporate significant design and customer experience allowing their rapid installation and use across a wide range of users.

The analyses¹¹ also allow differences between UK and German firms to be highlighted. The regularity of R&D is a factor increasing the propensity of German firms to internationalise but does not significantly influence the actions of UK firms. However, those UK firms which invest more in R&D as a percentage of sales are also more likely to internationalise. This direct relationship between investment in R&D and internationalisation did not hold true for German firms. Similarly, UK firms which employ more innovative technologies are also more active internationalisers. In Germany the innovativeness of the technology does not help to discriminate between internationalisers and non-internationalisers. These findings suggest a relatively more sophisticated industrial home market in Germany than in the UK.

The negative effects on internationalisation of high customisation or products designed for consumers or end-users appear to only be significant for UK firms. This disparity between the UK and German results may well be influenced by the more limited number of German survey records. Further, the internationalisation process may be qualitatively different in the two countries. For Germany, sharing contiguous borders with fellow European nations, the act of internationalising sales may be less disruptive or managerially demanding than for the sea bound and geographically more insular British. In addition, as suggested by our case study evidence, existing large domestic customers play an important role in the internationalisation of German start-ups. Products customised for these large firms in domestic markets may also fit well the needs of their foreign subsidiary companies.

A More Complex Comparison including Internationalisation ‘Thresholds’

The adoption of the concept of ‘thresholds’ of internationalisation allows the findings to be segregated between casual or chance internationalisers and more committed firms which have devoted substantial resources to internationalisation. The threshold was set at i) at least three foreign countries entered (see Table C-1), and ii) a minimum of 10% of total revenues from international sales (see Table C-1). The model compares these two levels of commitment to the base case of no international sales. Both model variants provide similar results to the Probit analysis but the specific threshold of three foreign markets produces a more analytically rewarding model.

That the number of international country markets entered is a better discriminator than the percentage of international sales is a useful finding in its own right, particularly for future researchers. What the multinomial regression allows us to develop is the concept of a *minimum threshold* for successful internationalisation activity. With the exception of the innovativeness of the technology which has a different effect in each of the two countries, customisation, regularity of R&D, international professional experience of the founders and the age of the firm are the key discriminators between internationalisers and non-internationalisers. However, the result of this analysis is to show that these variables have a significantly *greater* effect when the firm is involved in three or more international markets. The full power of these variables comes into play after the firm has crossed the barrier of casual, ‘happen-chance’ internationalisation.

¹¹ The full specifications of the multivariate models discussed are given in Appendix D.

2.6 Degree of Internationalisation

The above models deal with predicting whether or not a firm is likely to internationalise given its legacy of firm, product and market characteristics. The introduction of a threshold of International sales raises the issue of what determines the degree or extent of internationalisation activity.

For the purposes of this study, the degree of internationalisation is taken as the share of non-domestic revenues of the firm. There is a roughly equal chance that German and UK firms will internationalise over time. However, the descriptive statistics show that UK firms appear to have a significantly greater mean share (38%) of non-domestic revenue than their German counterparts (25%). These differences are material and add to the importance of also viewing internationalisation as a *scale* of activity.

Table 2-7:
Descriptive Statistics on the Degree of Internationalisation

Country Variable (in %)	Total Sample		UK		Germany	
	Mean	Median	Mean	Median	Mean	Median
Share of non-domestic revenue	33.9	23	38.4	30	24.8	15
Number of countries entered	9.6	6	10.0	6	8.0	5
% of firms with greater foreign than domestic revenues	28.5		34.4		16.8	

Source: ZEW & LBS, own calculation.

Two models were used to explore the issue of degree of internationalisation - an OLS regression (see Table D-4) and a Tobit regression (see Table D-6). The former model uses only the data from the internationalising companies whereas the Tobit model can also utilise the data from non-internationalisers. Both models predict correctly that German firms will have lower international sales than the UK sample firms. East German firms are likewise shown to be less likely to internationalise than their Western compatriots. Thus, the models confirm the empirical reality.

The size of the firms at start-up does not influence the degree of international sales (whereas this variable did influence the propensity to internationalise). However, engineering and life science sectors are more international than the base case of software. The longer the firm has had foreign sales, i.e. the greater its experience, the higher the level of internationalisation is likely to be. Co-operation with overseas or foreign partners is also a strong indication of higher international sales. The effect of technology intensity continues to be different for UK and German firms. In the UK, the level of R&D expenditures has a significant positive effect as does employing more advanced technology in the products exported. Neither of these factors increased the non-domestic sales of the German firms. The UK findings suggest a curvi-linear relationship with the degree of internationalisation increasing with the novelty of the technology but having its optimum effect before the most advanced form of technology is employed.

Unlike the earlier analyses, product characteristics do not strongly influence the level of international sales. German firms with a high share of non-domestic revenue were more likely to sell capital goods but customisation, installation and maintenance requirements do not effect the degree of international sales. This result would suggest again a threshold effect that once passed was no longer a factor. The provision of venture capital finance increased the level of international revenues but was only significant in the UK. The receipt of public grants was not significant and, for the UK firms, the coefficient suggested that a grant was more likely to be associated with *less* international sales. This was not the case in Germany where no significant result was recorded in either direction.

The Tobit model takes the probability of internationalisation into account before estimating the degree of internationalisation. As well as confirming the findings of the OLS model, it also indicates the importance of managerial skill shortages in reducing the level of international activities. This resource constraint only effected UK firms. The analyses confirmed the current importance of experience accumulated over time from selling abroad. For the British, pro-active behaviour coupled with advanced technology and innovative product solutions has a positive impact. This result was not found among

German firms in the sample. Finally, while there are significant differences among East and West German firms regarding the probability of internationalising, once the East German firm has crossed the threshold of embarking on international sales, there are no differences in their likely share of non-domestic sales.

2.7 Timing of Entry into International Markets

One of our most remarkable findings has been how quickly (as well as how extensively) young technology based firms seek to expand their markets to other countries. The dynamics of this phenomenon were examined using a ‘hazard function’ methodology which estimates the conditional probability of a firm having international sales in year t , given that it had no international sales in year $t-1$. This probability of international activity continued to be explored using the same independent variables, i.e. firm, management and product factors, by which the decision to internationalise was appraised. This hazard model was subsequently compared to a timing entry analysis which used a multinomial logit regression to differentiate between three respondent firm ‘states’, i.e. born-international, late-internationalisers, and those firms expecting to internationalise at some future date.

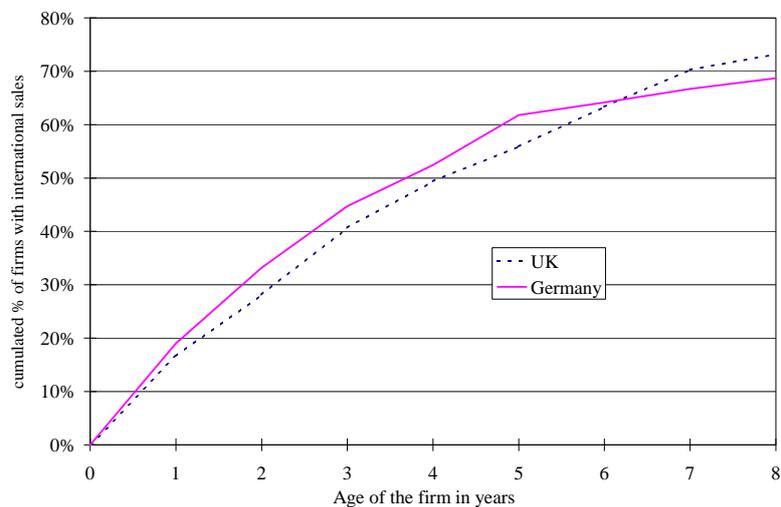
These analyses confirm the descriptive statistics. The timing of international sales is broadly similar in Germany and the UK with the former country tending to be a more active internationaliser in the earlier (first five) years. This may be because the barriers or sunk entry costs to foreign markets, including market research, investment costs and personnel recruitment etc., are lower for Germany which tends to make initial foreign sales to customers sharing common borders. West German firms internationalise more quickly than British firms which, in turn, internationalise more rapidly than East German firms.

Firms from the engineering, medical and pharmaceutical sectors are quicker to cross borders in the search of additional sales. It is likely that their products face low, industry specific, sunk costs. Foreign market barriers are not high as their products are familiar to foreign purchasers who do not require complex or costly adaptations.

The hazard functions indicate that the probability of a firm entering foreign markets increases over time. Larger firms, particularly, are not only more likely to internationalise but they also do so more quickly. The hazard analyses also confirm the importance of firm and product characteristics. Management experience abroad, and particularly in multinational firms, materially increased the rapidity of internationalisation activity. The permanence of R&D activity, rather than the intensity of research investment, also had a similar effect. Conversely, and as expected, consumer and end-user goods impeded the rate of international market entry. Highly customised products are particularly difficult to sell abroad. Skill shortages in sales and distribution also increased the time from domestic to foreign market entry. These findings on the timing of internationalisation are highly consistent, in their importance and direction of effect, to the analyses of international/non-international activity.

Importantly, the analyses also stressed the dynamic nature of the *process* of internationalisation. Approximately, three fifths of our sample had internationalised at the time of our survey – a maximum period of eight years. However, this fraction of the total sample would be expected to increase still

Figure 12:
Estimated Share of Internationalised Firms Since Start-Up by Country



Source: LBS, ZEW; Weighted data

further as the firms became older. By the end of the first decade, it was estimated that 80% approximately of the sample would be international to some degree. This finding suggests that the barriers to internationalisation erode over time. Thus, the time that the young firm spends exclusively in the domestic market can be viewed as a period of *incubation* prior to international sales. The incubation period may last several years but, for the majority, it is finite. That is, sooner or later, the great majority of high tech young firms become international.

The findings of the hazard analyses are a cause of optimism for those firms which do not immediately venture abroad. The findings imply that, over time, increasing domestic experience can compensate for the lack of those specific factors, e.g. managements' previous international experience, which tend to accelerate internationalisation activity. This research finding has a particular resonance for East Germany. It suggests that while East German companies may find the process of internationalisation initially more difficult than their West German counterparts, once in foreign markets, there is no evidence to suggest any permanent performance differences exist between firms from the former two states.

The act of internationalisation is ultimately a management decision. In order to model the strategic choice dimension, the sample was subdivided into the four categories of i) born-international, ii) late-international, iii) planning to internationalise, and iv) no foreseeable plans to internationalise. The latter category was used as the reference base case for the logit regression. With minor variations, the multinomial logit regression confirmed the importance of the independent variables identified in the hazard function analyses. Generally, the influence of these variables was less important if the firm had not yet internationalised despite its intentions. This has some positive implications. Resource endowments which encourage or discourage internationalisation appear to lose some of their influence over the lifetime of the firm. Thus, for example, the size of a firm at start-up becomes less influential as the firm gets older. Likewise, the barrier of intense product customisation lowers over time. Similarly, sectoral differences also decline. This suggests that as firms increase their experience in *domestic* markets this experience can also assist them over time to embark on the process of internationalisation. However, this benign effect of age should not disguise the fact that greater resources at start-up, particularly skilled and experienced management and a product with universal utility, are major assets in increasing both the degree and the speed of the internationalisation process. Particularly in new and emerging markets where a 'first mover advantage' exists, the above results should only offer little comfort to late-internationalisers.

2.8 Target Countries and Mode of Entry

The research has indicated that NTBFs internationalise extensively and rapidly. It can also be demonstrated that the strategic act of internationalisation is increasingly probable over time for firms that initially saw their markets as exclusively domestic. Thus, obvious and related questions include: to which countries do these internationalising firms go; and by what means (termed 'modes' or 'channels') is the internationalisation process executed?

The respondents were asked to name the first international market entered and their three most important international markets at the present time. For both British and German firms, Europe (defined as either the European Union or the European Economic Area) was the primary focus of both initial and current sales. However, Germany started and continued to be more European in sales focus than the UK, particularly if the emerging economies of Eastern Europe are also included. British companies had a significantly higher propensity to follow established, and more geographically widespread, political and trading alliances. History continues to be important. This resulted in North America (USA and Canada) being the single largest market for the British. France occupied this pre-eminent position for the Germans. Both exporting countries widen their geographic span over time. However, the British firms were more likely than their German counterparts to enter more quickly geographically and culturally disparate markets, e.g. Australasia and the Middle East.

Internationalisation is uncertain, time consuming and expensive. It is therefore especially risky for poorly resourced and inexperienced, young firms. Accordingly, the selection of an appropriate mode of foreign market entry is a judgement of critical strategic import to the entrepreneur. It was striking just how similar was the aggregate choice of entry mode of the two countries. Both German and UK companies chose to employ modes that were resource extensive. In practice, approximately 90% of all firms elected to export directly or via a distributor/agent. These low cost entry mode preferences hardly changed over time. The use of direct exporting or distributors/agents was and has remained the dominant modes for sample firms in both countries (UK 88%, Germany 82%). What has changed is that firms over time have tended to substitute distributors for direct exporting as the preferred mode. Between first and current entry mode, direct exporting had declined from 43% to 36% of all exporting modes. Conversely, the use of distributors had increased from 36% to 41%.

**Table 2-8:
Geographical Focus of International Activities**

Unit of Analysis	Firms				Entries			
	UK		Germany		UK		Germany	
Entry Mode	First country entered	%	First country entered	%	3 most important current entries	%	3 most important current entries	%
EU/EFTA	138	57	83	74	307	56	170	68
US & Canada	56	23	12	11	106	19	21	8
East Asia (Japan, HK, Sing., Korea, Taiwan)	14	6	4	3	37	7	14	6
Australia & New Zealand	6	2	0	0	25	5	1	1
Emerging Markets, Europe	2	1	10	8	12	2	22	9
South America	3	1	0	0	3	1	4	2
Middle East	11	5	1	1	22	4	3	1
Emerging Markets, Asia	4	2	3	2	12	2	11	4
Other	10	4	1	1	23	4	5	2
Total	244	100	114	100	548	100	251	100

Source: LBS / ZEW 1998

**Table 2-9:
First and Current Entry Modes**

Entry Mode	UK				Germany			
	First Entry	%	Current Entry	%	First Entry	%	Current Entry	%
Exporting	241	44	199	36	98	37	84	32
Agents	68	12	60	11	28	14	30	12
Distributors	198	36	227	41	91	38	96	38
Sales joint venture	12	2	27	5	2	1	2	1
Wholly-owned subsidiary	7	1	15	3	5	2	10	4
Licensing	11	2	9	2	8	3	10	4
Other	10	2	10	2	19	6	19	9
Total	547	100	547	100	251	100	251	100

Note: The table shows the first and current entry modes used in the most important foreign markets (three maximum) for the company's best selling product.

Source: ZEW / LBS 1998

The researchers chose to concentrate their analyses on these two most common modes of internationalisation. For the young firms, exporting directly under their exclusive control has many advantages. The firms learn first hand about important markets. Gross margins are not dissipated by having to share profits with distributors. Direct action has important managerial advantages. It is quick to organise and highly flexible in operation. However, management has to devote scarce time and sometimes incur heavy sunk costs in order to conduct this new activity. Critically, the channel decision may ultimately be taken out of the hands of the entrepreneurial managers if target customers in foreign markets are not prepared to deal with a new, unknown and untested company or its product. This adverse situation is termed by the authors "*the liability of alienness*". This liability may be resolved by utilising a distributor/agent/value-added reseller which is known and trusted by the target customer. The authority of the brand or franchise of the third party is extended to the companies that supply products via this channel. However, this route is costly and may only be available to the larger start-ups or those firms with conspicuously attractive products. The harsh reality may be for the majority of young firms that it is the distributor which chooses the young firm - not vice versa.

The assumption has been made throughout this research that the use of a distributor represented a *higher* level of resource commitment than direct exporting by the young firm. As has been evidenced in the case studies, firms utilising distributors have to invest considerable resources into ensuring good channel relationships. To be dependent on an alienated or disinterested distributor is perhaps the worst of all choices for a vulnerable young firm. However, the costs of using a distributor are not restricted to the resources consumed. Excessive reliance on the use of a distributor may also reduce the client NTBF's opportunities of 'learning by doing', as well as eroding the operating margins consequent on any sale. These dependent firms may well not forge the critical country and sector specific links with established commercial networks. Direct involvement in such third country networks may be ultimately necessary for independent survival and growth. There is a danger that the use of a distributor can result in the young firm ceding significant control over its future growth trajectory to the agent or intermediary. Dependency on a distributor in a key market may have major implications stemming from the reduced bargaining power of the internationalising firm (i.e. 'agency costs'). *In extremis*, the exporting firm may suffer the continued expropriation of significant rents by a distributor enjoying a quasi-monopolistic advantage.

The above concerns are issues of both strategic and policy importance. In order to determine which respondent firms used what particular channels of market entry and for what reason, a series of Probit regressions were run with the dependent variable being the binary mode choice of distributor or direct exporting (see Table D-1). For the UK, but not for German firms, a greater size at start-up was associated with using the more complex mode of a distributor. Sectors traditionally employing large sales forces include ICT hardware and pharmaceuticals. For the young firm, building a large sales force

represents a very major market barrier. Accordingly, respondents from these industries are more likely to use a distributor. British engineering firms are also more predisposed to use distributors but this is not the case in Germany. This difference may reflect the greater tendency for product customisation and specialisation in Germany. Customisation and complex installation procedures each strongly act against the use of distributors in both countries. Interestingly, high product maintenance demands increased the likelihood of UK firms delegating this role to distributors but encouraged German firms to export directly.

Higher R&D intensity, which is a *firm* based measure, was associated with exporting directly. A plausible logic is that the more technologically sophisticated products require direct contact between users and manufacturers in order to ensure their effective utilisation. However, in practice, higher levels of *product* innovativeness were associated with using distributors - the opposite outcome to that which was expected. It may be that the level of product novelty obligated the manufacturers to sell via a distributor. Customers may not have been prepared to adopt and purchase highly innovative, and thus risky, designs without the direct involvement and commitment of an established and experienced distributor.

Arguably, the persons who are most able to persuade industrial customers that using a distributor is unnecessary are the senior managers of the NTBF. This could help explain the finding that the more a firm's managers have living or work experience abroad, the more likely the firm is to export directly. The key fact here may be the authority or credibility of these senior managers with foreign customers. (The exact impact of the type of managerial experience differed between the UK and Germany although the general influence was in the same direction.). While senior management experience changed the firm's behaviour, the experience of the firm itself, as measured in the duration from first to present international sales, did not significantly influence the mode selected. This finding directly contradicts the logic of stage or process based models of internationalisation. However, caution is necessary given the limited duration of the observation period (usually less than six years) of the international activities of the respondent firms. The concept of advanced planning is often inappropriate in understanding the generic behaviour of either SMEs or NTBFs. Formalised planning is often a large firm practice. For the smaller firm, planning is often substituted by intuition and a reliance on a high level of operational flexibility. However, the strongest finding of the models attempting to predict the mode used was that respondents who include international sales in their *ex ante* business plans were very significantly more likely to use distributors. This finding was the same for both UK and German firms.

The inclusion of country specific factors did not produce consistent results between Germany and the UK. There was a tendency for UK companies to use distributors in large, target country markets irrespective of the latter's level of economic development. For German respondent firms, the absolute size of the market appeared not to be important. However, distributors were more likely to be used if the target market was economically developed. There was no conclusive evidence that firms in either Germany or the UK had a favoured channel strategy in order to enter any particular country or region.

2.9 Firm Performance and Internationalisation

It has been implicit in the entirety of this report, that international activity is an economically desirable activity. This means that young, high tech firms undertaking international sales are deemed to be more likely to increase the economic value of their businesses and/or they are likely to create more employment. These positive outcomes of NTBF activity are not only of interest to the firms' owners and employees. Government and an increasing body of private and institutional investors have a direct interest in the performance of high tech, young firms.

Labour Productivity

Labour productivity is widely used in micro-studies as one measure of firm performance. Our approach is embedded in the tradition of various micro-econometric studies which attempt to assess the effect of R&D on firm performance (see surveys by Griliches 1994, Mairesse and Sassenou 1991, Harhoff

1995). We employed the standard approach well known from these studies which was subsequently augmented by various factors to capture the impact of internationalisation on productivity. This standard approach at the micro-level is to assume that the relationship between a firm's output (sales) and inputs (capital, labour etc.) can be characterised by the well-known Cobb-Douglas function which relates factor inputs to firms output in an additive logarithmic specification. For estimation purposes, researchers usually transform and adapt this basic equation. Also, usually some additional controls are added and some further restriction imposed on the data.

One of the major motives hypothesised for firms entering international markets is related to the resultant ability to spread initial fixed costs across a larger output in order to realise economies of scale. Furthermore, some firms also indicated that they expect some positive effects from establishing close contacts with leading corporate users of their products or services. If these effects occur, they both should lead to higher factor productivity from firms with international business activities.

Besides some problems on constructing the capital stock the model incurs a number of endogeneity problems. These problems are solved by operationalising the internationalisation dummy, the venture capital dummy and the presence of public grants using their expected values. These values are generated from the Probit-regressions (see Table D-8). This has to be taken into account when interpreting the regression coefficient given in Table D-8.

The results of estimations indicate that the non-R&D labour productivity of firms which have internationalised was some 40-50% higher than domestic market only firms. Measured in additional, annual sales per employee, these productivity gains represent a marginal revenue of ECU 50-60,000. These benefits are likely to reflect the firms' abilities to realise economies of scale when no longer constrained by the limitations of their domestic markets. Similarly, the involvement of venture capital finance at start-up also increases the productivity of non R&D labour by an estimated ECU 30,000 per year. By whatever means, the involvement of venture capital finance allowed these nascent firms to exploit their potential more rapidly than in the absence of this source of finance. The positive effect of venture capital is in contrast to the negative, albeit insignificant, effect on labour productivity of receiving public grant finance. This suggests that the benefit of venture capital is not merely as an additional source of finance but is, in part, a consequence of the 'capital and consulting' package of benefits provided by these professional equity investors (MacMillan et al 1989, Sapienza 1992).

The results of the model also indicated a significantly higher factor productivity in Germany than in the UK. These estimates were much higher than expected. However, the model is measuring non-R&D labour productivity and the unusually high country differences would have been less if total labour productivities could have been used. R&D intensity also had a material effect on productivity. This would be expected given the sampled population was exclusively made up of NTBFs.

Sales and Employment Growth

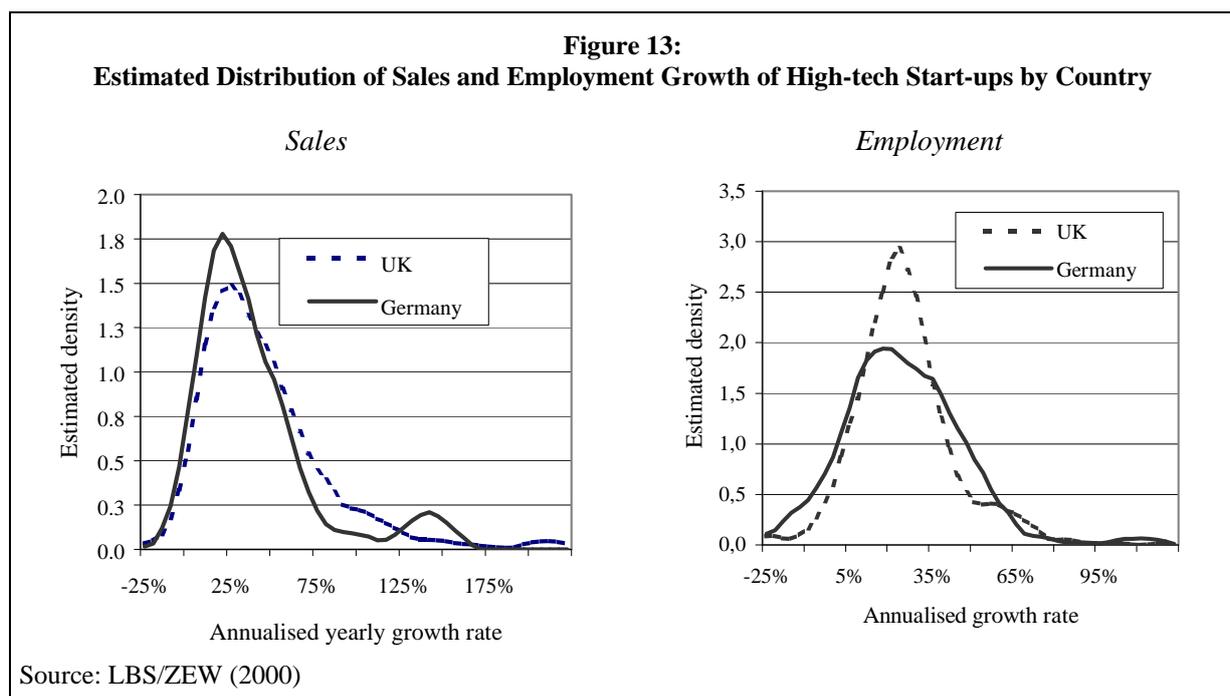
The 'average yearly growth rates' of both sales revenue and employment numbers was measured for the period from firm start-up until the time of the survey - an average period of approximately five years. What is immediately evident is the near 'normality' of the growth distributions both of which assume the classic, bell-shaped curve (albeit with a noticeable right tail reflecting a small number of high growth outliers). For surviving firms, the annual growth rates spanned 25-35% for sales revenues and 17-25% for employment. These are substantial and impressive performance figures. Closer analysis indicates that a bias exists towards UK firms at the higher levels of growth. For example, in employment terms, 15% of UK firms recorded a greater than 50% annual growth rate compared with only 13% of German firms. At 100% employment growth rates, the corresponding figures were 3.4% UK and 2.4% German firms. Thus, there is a tendency for high performance 'outliers' (cf. Storey's "Ten Percenters") to be British rather than German firms. However, the survey was conducted during a period when the German economy had recently experienced peculiarly severe economic pressures due to reunification and the largest economic downturn since World War II. Thus, national comparisons at the margin should be treated with some caution.

A central question of the study is ‘does international sales activity enhance firm growth?’ Accordingly, sales and employment regression estimates (see Table D-8) were made. They indicate an elasticity of *sales* growth rate from internationalisation of 13%. That is, a doubling of international sales would increase mean growth rates from 25 to 38% per annum. However, no similar, significant effect could be found for the impact of internationalisation on *employment* levels. This could suggest that entrepreneurs preferentially used internationalisation to generate sales, rather than additional jobs. This logic supports the finding that NTBFs frequently use agents for international activities. The former activity directly increases the value of the company and thus their personal wealth., Internationalisation help firms to exploit economies of scale. However, caution is again necessary as a large share of the additional sales and employment generation witnessed in this study is because of the exceptional performance of a small number of ‘fast track’ companies.

The regressions of average yearly growth rates produced a number of other interesting findings. While industry effects did not appear to influence growth rates, there was a strong negative effect of ‘initial firm size’. This supported the hypothesis that there is a minimum efficient scale and that firms below this threshold pay the price in reduced sales and employment growth. Similarly, the results showed a negative effect for age. The older the firms, the more likely that growth rates, particularly sales, will decline. Conversely, the larger the start-up’s founder team and the existence of a permanent commitment to R&D both increased growth rates (although R&D only affected sales performance.).

The dynamic of technology markets is illustrated in the effect of the ‘windows of opportunity’, i.e. the time period after product launch and before the firm experiences serious competition. A short window of opportunity of less than one year is positively associated with more rapid sales and employment growth. A longer window of opportunity is more likely to be associated with depressed employment growth. These findings would suggest that highly contested markets oblige firms to exploit their comparative (but eroding) advantages as vigorously as possible. This ‘product life cycle logic’ is supported by the finding that the age of the product is negatively associated with sales growth rates.

Arguably a more perverse finding, given the debate on the financial constraints faced by young NTBFs, was the lack of a statistically significant effect of either venture capital or public grant provision on both measures of firm growth in the combined Anglo-German sample (as opposed to factor productivity). However, the British sample shows a more significant, and positive, impact for venture capital investment than the German sample. The absence of a significant effect for venture capital finance across the combined sample can be partly attribute to the fact that we also include some strate-



gic variables in our models which are likely influenced by the presence of venture capital in a firm. Therefore, these variables already capture part of the venture capital effect. What we can conclude from our research is that the impact on venture capital finance is stronger in the British case and that the advice aspect of the VC presence is at least as important to a start-up as relaxing the liquidity constraint via the provision of equity finance.

The analysis of performance was extended by looking at those variables which differentiated between firms becoming fast or slow growth businesses (see Table D-8). The top and bottom deciles were used to set the boundaries of performance. This analysis was undertaken because it is important to recognise that these two groups within the last ten percent of a distribution represent both the largest job gains but also the largest job losses in the sample. Interestingly, the multinomial logit model was more productive in explaining fast versus slow employment growth rather than sales performance. Thus, an important finding was that extremely high rates of sales growth are a consequent of random shocks rather than robust associations with known variables. As with most things in life, it pays to be lucky.

This analysis confirmed that the German sampled firms are more likely than the British firms to grow moderately. This moderation extends to both sides of the mean. German firms are more likely to cluster near the central values for both sales and employment growth. This is particularly true for sales growth rates. Again, age reduced the chance of being a fast growth firm. The importance of having multiple (three or more) founders for fast sales growth was reinforced. The commitment to permanent R&D supported the fast growth of sales revenues and also lessened the likelihood of slow employment growth.

3 Results from the British and German Case Studies – The Qualitative Research Dimension

3.1 Case Study Analysis: Method and Process

The selection process led to 40 new technology based firms being interviewed during the Summer of 1998 in both Germany and the UK. Underpinning the chosen methodology, the purpose of the interviews was four-fold:

1. to corroborate the firm-specific data given in the mail questionnaire survey
2. to develop a better understanding of the nature and logic of internationalisation activity as perceived by the practitioner managers
3. to learn more about the background of the companies and their future plans in order to set the internationalisation decision within a strategic context
4. to search for possible patterns in the data from the matched samples

The case study interviews were not necessary in order to complete the findings of the quantitative analyses of the project. However, they were considered imperative to ensure the researchers appreciated, if not fully understood, the detail and richness of the firms' decision processes. The opportunity to establish a dialogue with founders and senior management was therefore constructed as an intrinsic part of the research agenda. This was deemed particularly important given that a number of the research findings may have relevance for prescriptive and policy-oriented, decision making.

Postal questionnaires cannot provide all the answers because this methodology has a number of serious limitations. In order to study more deeply the motivational basis of the companies' innovation and internationalisation behaviour, qualitative analysis offers a critical complement to survey questions. Personal interviews also allow survey information to be corroborated thereby increasing the latter's credibility. For example, written questionnaires are commonly designed to be answered by a founder or, at least, a senior and highly informed member of the management team. However, in practice, they are not necessarily completed by the founder or other key staff but are often delegated to subordinate staff. They, in turn, may not have the level of information or understanding required in order to answer accurately important questions. Qualitative queries on historic motivations or attitudes can be especially difficult when sought by remote and, largely uncontrollable, research instruments.

For the above reasons, we decided to undertake a series of individual case studies in both Germany and the UK. Continuing the matched sample methodology, the case studies included representatives of firms which had and had not internationalised. The former were categorised for analysis into Born-international and Late-internationalisers. It is important to stress that the findings from the quantitative results presented above in this research are in no small part a product of the insights gained from the forty British and German case studies. The founder managers of these high tech young companies gave the researchers a perspective and understanding which could not be obtained purely through the more remote vehicle of postal survey questionnaires. While the peculiar and specific observations of these forty respondents cannot be easily generalised, the researchers were impressed at the level of correspondence between the survey findings and the case study experiences. Observations are made which, it is hoped, add meaning and relevance to the statistical generalisations already described. However, these case study observations should *not* be taken as statistically validated findings. Rather, they represent possible opportunities for a greater comprehension of the data.

3.2 Timing of International Market Entry

The sixteen interviewed, born-international firms exhibited a very strong commitment to an international focus. This was pursued to the extent that some managers acknowledged that they had not paid sufficient attention to their home market. Ten of the sixteen firms traded in more than ten foreign markets. Importantly, the products of these born-international firms generally did not require extensive, customer-specific sales effort. Limited product customisation had assisted internationalisation. While the firms' products embraced innovative technologies, the employed technology was not so novel as to require complex and demanding installation or maintenance. Their increasing product ranges could be successfully sold and subsequently supported by intermediaries. This intrinsic functionality was an indication of the planning and managerial thought that had gone into the products prior to launch. This 'managerialism' was also supported by the finding that, with very few exceptions, the founders of born-international firms had extensive, international management experience.

One difference between UK and German born-international firms was that the latter tended to forge and maintain strong and close associations with a small number of large German industrial customers. A similar dependency of British born-international firms on a small number of large, UK customers was much less common. This may be in part because of an industrial structure in the UK with fewer large manufacturing firms existing than in the German economy. Generally, a strong attention on the home market and close relations to key domestic customers was a model of much greater relevance to German respondent firms. When these German firms internationalised, they frequently did so by selling to a foreign branch office or subsidiary of their traditional, domestic customers. This practice was nicely described by one German co-author as "internationalisation by convoy". It is a behaviour not generally adopted by British firms which remained more separate and less integrated with their larger customers.

Late-internationalisers should not be seen as necessarily less successful than their born-international counterparts. For some firms, the circumstances of their start-up precluded international sales. Sometimes the product was still in a quasi-development stage. In the case of one firm with medically related products, regulatory approval had not yet been obtained. These situations sometimes allowed local sales but not international activity. For other firms, the domestic market was highly attractive and there was little immediate pressure to seek foreign customers. Indeed, some late-internationalisers exhibited the fastest sales growth rates within the total sample. Successful late-internationalisers embarked on internationalisation for strategic reasons recognising that eventually their domestic advantage would erode as markets became more competitive and mature. Given the resources accumulated by these successful firms, they could embark on international sales using high commitment modes - as indeed two UK firms did. Given the primary importance that German firms particularly gave to their domestic market, late-internationalisers reflected a less global, and possibly more pragmatic, perspective than their born-international colleagues. They tended to sell to fewer foreign markets than the more quickly internationalising firms. Interestingly, late-internationalisers appeared to be started by entrepreneurs with less managerial experience than the born-international firms. However, the successful firms rapidly introduced a management culture into their growing businesses to accommodate the pressures of international growth.

The differences between an internationalising and a non-internationalising firm may ultimately be a function of time. Six of the seven non-internationalisers interviewed were currently considering international sales. For example, one non-international firm has, since being interviewed, signed a global licensing deal with one of the largest digital printing hardware manufacturers in the world. Within two years it has created four overseas sales offices. Only one firm thought that their product could not be sold outside their domestic market without incurring unacceptably high, transaction costs. This software product in the medical data management market exhibited very high asset specificity. Like late-internationalisers, non-internationalisers did not feel a commercial imperative to rapidly internationalise beyond domestic markets. They also shared a common characteristic that a number of the founders had little direct managerial experience. The effect of this was that several non-international firms noted that internationalisation would require new management skills. In the absence of such skills, the management believed that to embark on a process of internationalisation would seriously over-stretch the company.

It may well be that all the companies can best be differentiated by their relative positioning on a sigmoid 'firm development curve'. The degree of their internationalisation activities may be primarily dependent on elapsed time. The results of the hazard function analysis noted earlier would broadly support this contention. However, the case studies indicated that attitudinal and market variables did play some role. Certainly, the born-international managers expressed considerably stronger commitment to foreign sales. Also, they tended to operate in technology markets which, if described as niches, were international niches. Both late and non-internationalisers appeared less managerial than born-international managers. Their domestic markets often produced highly satisfactory revenues. However, for some and probably the majority of firms, there were signs that this domestic market sufficiency would not last indefinitely.

3.3 Fast Growing versus Slow Growing Firms

The differences between fast and slow growing companies were less equivocal. It was more legitimate to characterise an archetype Fast Growth Firm from the forty case studies. Such a firm was almost invariably founded and run by a small team of well-educated executives sharing considerable professional and management experience gained both from the home and international markets. The market opportunities targeted by the fast growth firms were large and expanding. Demand was not restricted to one country market alone. The transaction costs of reaching foreign markets existed but were not insuperable. This was in part because the firms did not normally sell highly customised or individualised products. The products on offer were often part of a related family rather than a single, one-off product. They incorporated innovative technology but rarely leading-edge science. Not being too in advance of contemporary user experience ensured both their acceptance and adoption by frequently large, industrial customers anxious for product security and reliability as well as added unique functionality. There was some evidence that the German fast growth firms emphasised the nature of their technologies more than their UK counterparts.

Of considerable interest was the fact that *none* of the UK fast growth companies had registered for legal protection of their intellectual property. In contrast, *all but one* of the German firms had taken out patent or copyright protection on their technological innovations. The UK firms justified their position by citing what they viewed as the excessive disclosure that the IPR registration process requires. The fast growing firms in the case study samples used both distributors and direct sales modes. However, there was some evidence that the fastest growth firms tended to sell directly.

Just as a fast growth NTBFs can be characterised generically, so too can Low Growth Firms be similarly defined. The two types of firm are broadly opposites. Low growth firms typically service small, niche markets. Without exception, all of these firms were supplying markets which the entrepreneurs did not believe would continue to meet their commercial objectives in the longer term. Very often, these markets were mature and already supplied by several competing firms. High value-added, high margin strategies were not appropriate or feasible for such markets which were usually highly price sensitive. Perhaps counter-intuitively, several of the low growth firms had attempted to internationalise often early in their life cycle. However, early internationalisation was possibly more a reflection of the limitations of the home market rather than a consequence of a pro-active, internationalisation ethos. Generally, their efforts had been marred by problems of insufficient resource commitment and weak execution. Although some foreign sales were achieved, strong reciprocal relationships with foreign distributor partners were rarely engendered. The mode of internationalisation selected was almost exclusively via distributors for the UK firms although German low growth firms were as likely to export directly. Overall, relationships with foreign distributors were remote and generally disappointing. This again may be a consequence of the noticeably less managerial experience and professional training of the founders. Negligible management training should not be equated with poor educational levels. On the contrary, the level of education of low growth company founders was uniformly high. However, this training was restricted to technological rather than to commercial aspects of their enterprise.

3.4 Formal and Informal Sources of Venture Capital

The case study firms were specifically chosen to reflect characteristics of interest including sources of finance. Thus, ten UK and six German companies each having received equity from an external investor were selected. In the case of the UK case studies, the ten firms had received formal venture capital. Six of these UK firms had also attracted business angel or informal venture capital finance. Four German firms had accepted venture capital and a further two firms had business angel finance. These statistics purposely do not mirror the survey sample where less than 10% of all respondents had attracted external investors of any kind.

The investment selection preferences of venture capitalists were clearly evident. Virtually all externally financed firms had been founded by management teams rather than by individuals. The firms were pursuing growth strategies which were multi-country in focus although they continued to adopt resource extensive marketing plans. It appeared that the business models of the recipient firms were designed in part to attract the attention and interest of professional equity providers. Young firms appeared to have become more informed or better advised on the selection criteria of professional investors and were behaving accordingly.

The advice available to the young firms from their venture capitalists was generally centred on financial reviews and strategic plans. The financiers almost never made any detailed contribution to technical or market related issues. A certain ambivalence to the value and role of the venture capitalist was expressed by several of the respondents. The provision of finance was seen as their primary and sometimes *only* valued role. Concern with the potential legal authority of the venture capitalist over the investee firm's assets in times of difficult firm performance was a particular cause for concern. German entrepreneurs were especially against an external financier being able to prejudice the entrepreneurs' ownership or control of the businesses that they had founded. Yet, generally, German respondents were more respectful of venture capital firms and their potential role than the British firms. This is perhaps a worrying finding given that venture capital is much more available in the UK. British firms are more likely to have greater information and/or first hand experience of contact with equity investors than their German peers. Interestingly, it was the managers of firms which had *actually* used venture capital, rather than those with 'hear-say' experience, who were most positive about the benefits of an external 'partner'.

The advice available from business angels was generally held in greater regard by the entrepreneurial managers. This is not unexpected as a business angel is very often a successful 'entrepreneur turned investor'. Given that they tend to invest in commercial areas where they have direct and detailed experience, their ability to add value is more immediately obvious to the entrepreneur or manager. Despite the skills, experience and considerable levels of finance of the venture capitalist, the impression is given that many founder managers are happier with the (supposedly) potentially less threatening relationship with an informal investor.

Although venture capitalists were on occasion prepared to back bold business models, the respondents frequently gave the impressions of having dealt with professional investors with relatively short term, investment horizons and little appetite for the necessary risks and uncertainties of early-stage technology investment. A small number of investee firms suggested that the short term and 'selfish' interests of the financier could sometimes threaten the financial security of the investee firm. Only one respondent had obtained seed capital from a venture capital investor. Perhaps alarmingly, three highly successful internationalisers observed that their venture capitalists had each been extremely reluctant to support initially the firm's internationalisation plans. However, it should be noted that external investors and their trustees have a fiduciary duty to manage their funds prudently. Such responsibilities are occasionally likely to conflict with the exaggerated expectations and optimism of some investee firms. As such, venture capitalists are an easy target for criticism irrespective of the value of their economic contribution. It is noteworthy that the British entrepreneurs with direct experience of private equity were generally more positive about venture capitalists than the German owners of young high tech businesses. The UK has the largest and most developed venture capital industry in Europe. Accordingly, British entrepreneurs have had much longer to reflect more objectively on the pros and cons of this form of finance.

3.5 Small Business Grants from the Public Sector

Grants represent an alternative or complementary form of finance to young firms. However, in reality, given the modest size of most public sector transfers to small business, this form of finance is rarely a substitute for commercial funding. The forty case study firms could be segregated into three separate categories given the entrepreneur's attitude and response to public support measures for new enterprises:

1. Successful firms which actively sought multiple grants and presented a professional and informed attitude towards acquiring public sector support
2. Successful firms which did not apply for public grants seeing them as inappropriately time consuming and inflexible for rapidly growing businesses
3. A majority of firms which were generally poorly informed about the available resources from public support schemes and whose applications, when made, were often relatively unprofessional. These firms were less likely to be successful at gaining state assistance than Group 1 but are likely to comprise the majority of grant applicants.

The first group are highly efficient seekers of public subsidy particularly for the early, critically resource constrained, stages of a young enterprise. They also meet the needs of grant providers anxious for credible and successful grant applicants in order to demonstrate the relevance and effectiveness of their grant programmes. This group's professionalism also makes them attractive to venture capital firms. Two-thirds of the venture capital financed firms had also received public grants - usually prior to negotiating external equity. The second group is often as commercially shrewd as the first group. However, they see the opportunity costs of applying for grants as unacceptably high. The primary cost is the time necessary to prepare for and complete a full application form. This can be a substantial information collection exercise requiring the assistance of a consultant and/or an accountant depending on the size of the grant claim and the complexity of the grant scheme. With limited managerial resources and demanding commercial goals, this second group did not see the net advantage of public grants. Indeed, these respondents are commonly quite hostile as they perceive public funds being awarded to either those who often do not need the grant (i.e. Group 1) or those that should not be encouraged as they are, in their opinion, economically marginal (i.e. Group 3). This third group which is numerically the largest community is most in need of public grants. However, their limited professionalism is such that they are the least likely recipients (in terms of the percentage of successful applications). They are usually poorly informed about the availability and appropriateness of extant grant instruments.

There is almost universal criticism of the complexity and time consuming nature of public grant applications among the potential claimants for such grants. Arguably, a more serious criticism is the inflexibility of grant schemes to the particular needs of target firms deemed suitable for support. The distribution of information available on grant schemes is also highly skewed. This is particularly the case for European Commission grants as opposed to national grant schemes. The former schemes also commonly require co-operating partners in two or more countries. The organisational demands of arranging such trans-national, intra-Community co-operation can be a very serious, and thus highly undesirable, time burden on a newly formed or young high tech firm. Only three firms among our forty case studies had received grants from any source which could be broadly described as relating to internationalisation activities.

Overall, the impression was gained that public sector grant schemes did not appear to impact significantly on the fortunes of the respondent firms with regard to the initiation or development of international activities. Grants may have helped internationalising firms but there is no evidence that the available grants encouraged internationalisation. However, grants can have a positive role and effect, particularly for (the majority of) NTBFs which have been started with insufficient finances. Grants can also encourage the adoption of good practices by the entrepreneurial manager applicants. The very act of having to present formally documented evidence of future plans, market analyses and outline cash flows obliges the applicants to think beyond narrow operational horizons. Yet, there appear few assistance programmes specifically designed to help founder managers and their young enterprises

to target and gain experience of potential foreign markets. UK firms cited that the most immediate 'trigger' for international sales was a visit to an overseas trade show. One German firm alone in our forty strong case study sample was specifically grant aided to visit a trade show. However, from the evidence of these case studies, such funding was not common (or perhaps not known to the entrepreneurs). There appears to be some merit in exploring the potential demand for a small but flexible overseas travel/accommodation grant for NTBFs which would be awarded rapidly and with little bureaucracy to eligible applicants¹².

3.6 Differences between German and UK New Technology Based Firms

What has been well corroborated by this research is just how *few* are the important differences between German and UK high tech start-up and young firms. Country based differences certainly do exist in firm characteristics and behaviour but they tend to be at the margin. In many respects, the distribution of the descriptive variables of the firms in our survey would suggest that the respondents came from the same underlying population *regardless* of their nationality. However, there are a number of important differences between the German and British sample firms. At the risk of propounding crude stereotypes, there appear to be specific characteristics which can be described as typically German or typically British. These differences may be usefully interpreted and illustrated in the differing attitudes of the managers to risk and to uncertainty.

German new enterprises tend to start with a larger number of founder employees than their British counterparts. A significantly larger proportion of German start-ups is in the software sector, arguably the least resource intensive of the five sector classifications selected. At the time of formation, there is a marginally greater probability that the UK teams will have had prior experience of working with each other. UK managers are also more likely to have worked abroad or had previous work experience with an international firm. Somewhat less German firms undertake R&D. However, those firms which do undertake R&D invest a greater proportion of their total sales into this activity than the British firms. None the less, German firms are less likely to undertake permanent rather than occasional R&D activities compared to British firms.

Shortages of skills affect both German and British firms. German firms are more likely to record shortages at start-up in the business skills of finance, sales and marketing. However, the German firms have a better record of correcting these shortcomings over time than their UK counterparts. British firms are particularly weak in addressing chronic R&D staff scarcities. This finding appears perhaps contradictory as UK firms are overall more likely to use technology developed internally rather than by third parties. This is especially the case for the smallest size category of firm.

German firms are more likely to sell capital goods or products to end-users. Their products are also likely to be more customised and to require greater individual effort, in order to install and to train users, than the products from UK firms. However, the high level of technology used cannot allow any differentiation between domestic and international customers. Typically, German firms will sell predominantly to large industrial users initially through domestic contacts. Over time, the sales relationship will develop into a close, long term, integration of suppliers and customers. Early internationalisation tends to be via the development of sales to foreign client firms owned or controlled by key customers in the German domestic market. The new country markets entered are predominantly European with the exception of the USA.

UK companies in common with their German counterparts are likely to sell approximately 70% of their total exports to other European countries and to the USA. However, their residual export sales are much more likely to be in geographically more remote markets, for example, the Pacific Rim or South America. British companies are much less likely to forge tight relationships and supply customised products to key, large company customers. Rather, they are more likely to sell more uniform and scaleable product types to a diversity of customers in a diversity of countries. These export customers

¹² Such grants may already exist. However, if they do, they are unknown to the forty case study representatives

in aggregate will be economically more important. In consequence, over time the home market will become less significant to British suppliers than to German firms. America represents the UK's largest foreign market. France is both Germany's immediate neighbour and its largest export market.

The impression is given from both the survey and the case study findings that German firms prefer to contain and diminish the risks and uncertainties endemic to the international sales process. Selling customised products to long term, large, industrial (and ideally German owned) customers both at home and in foreign markets is the preferred state. Trading relationships are not occasional or chance but are the result of purposely nurtured ties of mutual benefits and obligation. Significant effort is put into network relationships by German firms and these bonds are expected to last. One consequence of this may be the already noted higher non-R&D labour productivity of German firms. In contrast, UK firms are less likely to elect to go for the certainty or stability of the German structure. Rather, they rely on their international experience and cultural links. These endowments are coupled with strong entrepreneurial skills of sales, distribution and marketing management. Collectively, they are used by the British to seek out and exploit markets on a world-wide basis.

Given the endemically high rates of change within new technology sectors, particularly in electronic software and hardware sectors, it is not yet clear as to whether the longer term, integrated relationships of German habit and preference are more productive than the alternative, more opportunistic, British predilection for higher rates of firm adaptability. For example, the typically high levels of integration between German suppliers and their large industrial users mean that the relationship is highly efficient as a dyad. Yet, this strong bilateral relationship may severely weakened the young NTBF supplier's abilities and opportunities to search for and exploit other product/market advantages with different customers (see Bower and Christensen, 1995). Using Burgelman and Grove's (1996) concept of the "strategic inflection point", there may be a time when the young firm should pull back from an increasing integration with one or small number of local partners and seek wider product applicability (i.e. less 'customisation') and greater scalability. It is perhaps indicative, although certainly not conclusive, that the fastest growing firms in the survey were almost invariably from the UK. The case studies suggest that these 'outliers', which represent about 5% of the total survey sample, are highly international. However, they are more likely to sell overseas directly than through distributors. They are not necessarily 'born-international' and frequently exploit initially the opportunities of a large home market.

4 Conclusions

4.1 Eighteen Research-Based Lessons for a Would-be International, High Growth, New Technology Based Firm

As stated in the introduction to this research exercise, one of the ambitions of the researchers and their sponsors was to generate relevant, practicable and research-validated advice for high tech young firms. Accordingly, the key results of the research analyses have been reduced to a series of eighteen recommendations or perhaps, more modestly, insightful suggestions. To some managers, they may not appear particularly exciting or novel. However, in each case, these recommendations are directly associated with the behaviour of large groups of firms which have demonstrated superior international performance in the survey.

1. ***Recruit as good a team of founders and professional managers as possible*** with high levels of international experience, preferably gained in working with and for both large and small firms.
2. ***Start as large as possible*** including the size of the founding team and the financial, technical and experiential resources available.
3. ***Incorporate highly innovative technologies*** into products and services but not at the cost of compromising either usability or reliability for customers.
4. ***Select high margin products which are sold to industrial users*** rather than to end consumers.
5. ***Build a portfolio of demanding customers*** but do not become excessively committed to or integrated into the non-standard needs of a few large customers.
6. ***Design a business model that is scaleable*** in both volume and number of product-markets targeted.
7. ***Commit the firm to international sales from Day 1*** in both actions and all planning targets.
8. ***Be prepared to enter additional new countries rapidly*** after the first internationalisation activity.
9. ***Plan for significant additional costs*** in developing international sales and marketing activities.
10. ***Appraise product markets*** in terms of long run, aggregate international demand rather than short run, domestic demand and growth.
11. ***Develop and properly finance a permanent and focused R&D activity.***
12. ***Avoid 'deep niche' products*** if high growth is a desired goal. Ensure a range of applications for both products and technologies.
13. ***Continue to find ways of reducing product adaptation/transaction costs***, particularly the installation and maintenance costs incurred by new customers, distributors or the vendor.
14. ***Assess rigorously the 'pros and cons' of exporting direct versus distributors***, and consider the effect of industry sector, target country and technological innovativeness on channel selection.
15. ***Manage distributor relationships effectively and fairly*** recognising the need for continued reciprocal investment of time and resource.
16. ***Get known quickly*** and recognise the "liability of alienness", i.e. larger firms, particularly customers, are likely to be very wary of entering into trading relationships with unknown firms
17. ***Be prepared for the rapid entry of new competitors*** into your product/market space.
18. ***Consider external finance*** (venture capital, business angels, grants) and recognise particularly the consequential benefits of enhanced factor productivity, reputational (i.e. endorsement) effects and the greater access to professional advice for fast growth firms.

4.2 Implications of Research Results for Government

In the context of high-tech industries, the activities of starting-up and internationalisation have been shown to be eventually 'two sides of the same coin'. Thus, if governments are interested in the promotion of successful NTBFs they also must, necessarily, be interested in encouraging the processes of internationalisation.

The higher the level of heterogeneity between firms, sectors and countries, the more macro-economic policies become the more appropriate instruments. For example, discussions of currency valuations and their consequent impact on industry are normally couched in terms of their effects on large companies. Large firms, both in manufacturing and service industries, are seen as being the nation's primary exporters. However, our results suggest that small and young firms that sell into foreign markets will also be materially influenced by these same factors as are larger exporters. The more the young firm has products which are *not* customised (and are thus likely to be more price sensitive), the more adverse currency movements are likely to have an effect on its competitive position. This may be a cause for concern given that we have argued that firms have to go beyond niche and customised sales strategies if they are to grow rapidly in overseas markets. During this product transfer process, a relatively stronger domestic currency has a direct and negative effect on the aggregate demand and, thus, the profitability of immature young firms.

In addition to the classic macro-economic implications of currency valuations, there are three other macro factors which are important, albeit not exclusively, to NTBFs. The research has shown that all start-up firms are likely to experience human capital constraints in one form or another. The issue for government is whether or not the extant educational and training infrastructure resolves these problems effectively over time. The results would suggest that German firms are located within labour market systems which are more able to identify and reduce skill shortages than the systems available to their UK counterparts. Given that young knowledge firms are initially, by definition, little more than the disparate and aggregate skills of their employees and founders, the observation that British firms find little correction for persistent R&D staff shortages over time is of considerable concern. These findings support recent criticisms in the UK of the effectiveness of the vocational training provided via the public infrastructure.

The question of the mobility of labour is not only a problem of geography. It also concerns whether or not experienced managers will take on a significant career risk and move from large firms to start-ups or young, technology firms. The research unequivocally shows the advantages to the new firm of the founders or early employees having significant experience abroad and/or in large, international trading companies. Here, UK firms appear to be more advantaged than their German peers. The result of this advantage may be ultimately evidenced in the significantly greater proportion of international sales per firm in the UK than in Germany over time. The encouragement of managerial mobility is likely to be strongly associated with appropriate reward systems, and the tax treatment of managerial incentives including both share options and capital gains. These research findings reinforce the importance of finding a workable solution regarding the current debate on the role of fiscal measures to encourage entrepreneurial action and risk taking. In essence, experienced managers should be encouraged and supported to make the leap from large, established corporations to start-up, technology based firms. The researchers felt that the UK was at present more entrepreneurial and risk accepting than Germany. However, the authors also believe that this situation is clearly changing for the better in Germany and will erode the UK's relative advantage in this area.

Finally, the capital markets should ideally be a powerful ally to potentially fast track young firms. If US experience is relevant, an established market for venture capital should particularly be an asset in any economy wishing to encourage the genesis and growth of NTBFs (see US Senate 1999 and Gill et al. 2000 on the USA experience). Yet, the Anglo-German results are somewhat ambivalent. Despite the major renaissance of technology investing in Europe since 1995, venture capitalists still seem not to be heavily involved at the earliest and most speculative levels of enterprise investment. 'Seed capi-

tal' from formal venture capital companies remains in short supply. However, the contemporary high valuations of nascent and immature e-business stocks has created a rapid influx of speculative money to this sector. There is starting to be additional evidence that the new interest in technology related, e-business start-ups is also migrating to other technology stocks including life sciences.

There was no direct and unassailable evidence from the combined sample that the provision of venture capital was directly associated with firms that rapidly internationalised and/or grew more quickly than other firms. Approximately nine respondent businesses in every hundred technology based firms in our sample had received venture capital finance. Generally, UK firms were more sensitive to the impact of venture capital finance. It was found that having a venture capitalist backer had a positive effect on export activity if the firm had already decided to export. Yet, its receipt by a firm did not significantly increase that firm's probability of exporting. Perversely, a number of case study respondents suggested that, on occasions, venture capital executives were less than supportive of their firms' internationalisation ambitions. However, in the larger and more experienced British venture capital market, there is evidence of some positive impact of venture capitalists on the above average success of their investee firms in international markets and, hence, on firm growth. It would appear that the benefits of venture capital may be more evident in indirect and subtle benefits such as access to professional support and to the investors' networks rather than just because of the equity funding alone. This can be evidenced in the significantly higher productivity of non R&D labour in venture backed firms. However, as a source of informed finance, the role of business angels or informal investors is broadly viewed in a more positive light by investee firms in the survey. Business angels are more readily seen as being able to offer valuable operational and strategic advice to the NTBF founders and their employees. None the less, it should be noted that experienced recipients of formal venture capital finance are among their strongest supporters and advocates. The researchers expect to see an increase in the influence of venture capitalists on the performance of their investee companies over time. It is believed that this effect is likely to be greater in Germany given the relatively less mature nature of the German private equity market including technology investing compared to the UK.

As has been noted, there are no negative effects of government grants on the productivity levels of their NTBF recipients. Thus, at least on this measure, government is not financing less attractive projects than those firms with exclusively private investors' support. However, there is a persistent argument from investee companies that public grant systems are too complex and too inflexible for the dynamic environments in which NTBFs currently find themselves. It is suggested that new technology based firms face peculiar conditions which are as much a reflection of their technology focus as their status as young enterprises. Pre-commercial funding (seed capital) continues to remain a problem at levels above the 'boot-strapping' resources of the entrepreneur(s) and his/her family or friends. All SMEs suffer from the costs of obtaining appropriate and timely information. These information asymmetries can be particularly problematic in the knowledge intensive and turbulent industries in which NTBFs exist.

A plausible argument can therefore be made that NTBFs should have a part of their necessary information search costs underwritten by the state. Legitimate expenditures could include, for example, visits to foreign trade fairs or undertaking market research on target countries. In the absence of this incentive, there is a danger that many young, high tech firms will remain ill informed and, thus, more vulnerable. The same argument can be extended to the costs incurred in building up the 'information infrastructure' of the firm including commercial relationships and networks. Dissenters may well argue that existing public schemes can accommodate the peculiar needs of NTBFs. However, the evidence of the survey, particularly reinforced by the case studies, would suggest that this is not the case. The level of both information on and usage of public grants and support mechanisms was relatively low. Critics of the case for the state underwriting part of the information costs of NTBFs, make the point that 'information push' does not work. They argue persuasively that it is the responsibility of the entrepreneur to marshal all necessary resources including information in order to ensure the success of the enterprise. However, if there are information asymmetries which can be shown to result in a sub-optimal supply or growth of NTBFs, there still remains a technical case for public subsidy. Further, if the state provides grants, it has a consequent responsibility to ensure that a reasonably competent en-

trepreneur has little difficulty in becoming aware of the existence of such grants and can make an application without a disproportionate commitment of scarce resources.

4.3 Some Brief, Concluding Observations on 'Theory'

While this research has attempted to answer some questions of direct operational relevance to high technology entrepreneurs, it has been grounded in an understanding and critique of the relevance of those academic models which attempt to comprehend the nature and logic of internationalisation. The questions asked of both the survey and case study respondents therefore have had two roles. The researchers wished to understand what factors were important to internationalising firms and whether or not our current theoretical understanding corresponded with this empirical reality. Essentially, the theories can be divided into *behavioural* or *economic* constructs. In the former category can be included internationalisation process models, stage theory models and network models. Economic models embrace theories based on transaction costs/internalisation or on the consequences of imperfect markets including monopolistic advantage or oligopolistic behaviour.

A more detailed treatment of internationalisation theories and their relevance to the current research may be found in Bürgel (1999) who makes the point that our conceptual knowledge is severely limited especially when we address the dual foci of new technology based firms *and* internationalisation. For the purposes of this summary chapter, it is sufficient to observe and comment that none of the theories provided a totally confident or consistent explanation of our empirical findings. By the same token, none of the theories totally lacked credibility. For example, stage theories, suggesting an evolution of behaviour over time as a consequence of accumulated managerial experience, are highly plausible. This is despite their criticism by academics for being tautological and excessively prescriptive. None the less, firms generally appear to enter first foreign markets that are most similar to their home market first. They also tend to increase the level of commitment and resources dedicated to international activities over time. These observations would lend support to the behavioural school of thought and especially the concept of 'psychic distance'. However, a not insignificant number of firms entered geographically and culturally remote markets soon after formation. Several firms also made resource intensive, foreign market commitments early in their life cycles. These contrary examples serve to reduce the universality of these process or stage models of internationalisation.

Transaction cost theories, explaining the internalising of cross-border operations where market based services would engender unacceptable levels of cost and/or risk, were also less than comprehensive in their ability to explain our research findings. The transaction costs of installation, maintenance and training were not important variables in determining the decision to, or the degree of, international activity. Only product customisation, which required significant commitment of technology resources, appeared as a major barrier to internationalisation. Indeed, the higher the level of R&D expenditure, the more likely a firm would use an intermediary to conduct international activities. Transaction cost theory would suggest that greater investment in research would lead to greater asset specificity which in turn would lead to the internalisation of the activity in order to manage the consequent monitoring costs. The evidence is highly ambivalent. NTBFs appeared to accept rather than avoid transaction costs - in part because they often have little real choice.

The correspondence of theory and practice was most evident when appraising the empirical findings through the lens of the 'resource based theory of the firm' or the related 'organisational capabilities' perspective. These constructs with their focus on the economic nature of competitive assets (both tangible and tacit) are successors to the economic models of imperfect competition. The research hypotheses which concentrated on imperfectly imitable, firm specific factors received support. Thus, the previous international experience of the founder managers and the technological innovativeness of the firm's products each had a significant effect on the processes of internationalisation including the selected mode of internationalisation. For example, the more the experience of management in foreign markets, the more likely the firm will export directly. However, the greater the innovativeness of the technology employed in the firm's products, the more likely that a sales intermediary will be used.

Perhaps one of the most interesting insights was from this last observation that firms elected to use intermediaries to sell technologically innovative products. The use of a third party would appear sub-optimal given that economic rents have to be shared and there are additional monitoring or governance costs. Yet, none of the internationalisation theories consider *organisational legitimacy*. It is assumed that customers will use the best technological solution irrespective of the nature of the provider. The reality is very different. Small high tech firms with little history or market presence are likely to be ignored by larger firms as representing too great a source of uncertainty. In order for the NTBF to make a sale, it may have to purchase credibility by seeking to be accepted by an intermediary its end customer will recognise, e.g. an internationally known, value-added reseller (VAR). Thus, the use of a distributor or agent may be economically sub-optimal but may also remain the only viable option, at least initially, in order to sell to large industrial users. The intermediary is used to overcome what we have termed “the liability of alienness”. This concept takes the theory materially nearer reality as it is experienced by the technologically innovative young firm.

4.4 ...and finally: Areas for Future Research

This study has involved a team of academic researchers in both Germany and the UK and has encompassed a range of related disciplines from Economics and Management Studies. A highly refined methodology including both postal survey and case study interview instruments has been developed, tested and employed in two major European economies. There is obvious value in extending this work to other European and non-European centres. For example, Germany and the UK are both northern European nations with strong cultural and economic similarities. The situation and international behaviour of NTBFs in the southern European countries of France, Spain or Italy may be significantly different. Yet, each of these cited countries has a substantial domestic market. This is not the situation facing the new technology, small firm sectors in, for example, Belgium, Israel or Australia. Our knowledge in the West of the contemporary circumstances facing NTBFs in the export oriented economies of South Korea, Taiwan or Japan is even more parlous.

The domain of technology based, international entrepreneurs is poorly developed as a research focus with the exception of the valuable contributions of a few scholars. The depth of knowledge and contacts made in the present study could, and should, be cultivated to allow eventually a longitudinal perspective and analysis. How do our 500 plus British and German young companies develop over time? Will any evolve into world class, technology companies able to compete with American or Asian exemplars? Can we help address the policy question of why so few European technology firms attain international dominance? In part, the future success of NTBFs might be conditional on their ability to flourish within the more dispersed and intangible, networked linkages available to technologically sophisticated firms. When, where and how do these firms collaborate or compete? What options are available, and successful, to ambitious firms with high levels of tacit knowledge but few tangible assets particularly in relation to existing market incumbents? What value over time do outside sources of finance and advice really provide? Each of these questions invariably will need further elaboration when both country and sector/technology specific dimensions are added.

Internationally focused, new technology based firms are a fruitful subject for further study and analysis. They represent a source of current and future value to society that no developed economy can afford not to recognise or to nurture. We hope that our present study has helped to move these high tech entrepreneurs more to centre stage - a position that they most assuredly deserve.

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Appendix A Definition of 'High-Tech' Industries

**Table A-1:
Definition of 'High-Tech' Industries**

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
Misc. 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 Speedcraft Manufacturing

Appendix B The Questionnaire (UK)

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 ____

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: _____

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:

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 Project Homepage: <http://www.intsme.zew.de>

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	<input type="checkbox"/>							
Sales / Distribution	<input type="checkbox"/>							
Financial Management	<input type="checkbox"/>							
General Management / Organisation	<input type="checkbox"/>							
Production, Manufacturing, Logistics	<input type="checkbox"/>							
Research and Development	<input type="checkbox"/>							

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)

Venture capital:

Initially at start up:

yes: _____ %

yes: _____ %

yes: _____ %

To date:

yes: _____ %

yes: _____ %

yes: _____ %

Government / public grants:

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	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Individual client customisation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Specific configuration / system requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Complex or time-consuming installation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Regular maintenance and/or upgrades	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Specialised training required for front-line and sales personnel	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other key characteristics, please specify:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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:

Intensity of competition: none very intense 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

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	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Adaptation to regulatory requirements	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Packaging and sales documentation	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Other important product/service changes required, please specify:	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
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	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
30. Please indicate the sequence of entry / foreign sales modes:	first entry mode current sales mode	first entry mode current sales mode	first entry mode current sales mode
(e.g. A - E, see codes below)	_____ _____	_____ _____	_____ _____

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? | <input type="checkbox"/> Yes, please specify: _____
<input type="checkbox"/> No | <input type="checkbox"/> Yes, please specify: _____
<input type="checkbox"/> No |
| 32. Do you expect to use a different sales mode in the foreseeable future? (please use the above codes) | <input type="checkbox"/> Yes, please specify: _____
<input type="checkbox"/> No | <input type="checkbox"/> Yes, please specify: _____
<input type="checkbox"/> No |

Appendix C Summary Descriptive Statistics

Table C-1:
Summary Descriptive Statistics

Variable	UK Raw Data		Germany Raw Data		UK Weighted Data		Germany Weighted Data	
	Mean/ Share	Std. Dev.	Mean/ Share	Std. Dev.	Mean/ Share	Std. Dev.	Mean/ Share	Std. Dev.
West German Firm			0.66				0.75	
East German Firm			0.34				0.25	
ICT-Hardware	0.21		0.18		0.18		0.11	
Engineering	0.17		0.13		0.14		0.07	
Bio/Med/Life	0.09		0.08		0.07		0.05	
Other Industries	0.26		0.31		0.22		0.18	
International Sales	0.71		0.63		0.63		0.56	
Employment at start-up	4.47	6.72	5.88	8.39	3.98	5.89	4.65	6.13
Employment 1998	20.17	23.70	18.85	21.17	16.3	21.38	15.22	18.40
Age of the Firm (1999)	7.08	2.42	6.49	2.21	6.8	2.44	6.08	2.19
Venture Capital Backed	0.11		0.09		0.1		0.09	
Public Grants Recipient	0.18		0.27		0.14		0.2	
Work experience abroad	0.53		0.31		0.52		0.31	
Work experience in MNC	0.51		0.35		0.48		0.35	
Education abroad	0.13		0.15		0.13		0.15	
Number of Founders:								
- 2-3	0.43		0.28		0.44		0.29	
- 3-4	0.2		0.31		0.18		0.29	
- 5 and more	0.05		0.07		0.06		0.08	
R&D employment share (in %)	20.86	19.74	19.62	20.15	22.78	21.62	23.03	22.61
R&D performed occasionally	0.27		0.31		0.31		0.36	
R&D performed permanently	0.6		0.49		0.56		0.41	
Window of Opportunity								
Larger than 1 year	0.53		0.59		0.53		0.6	
Unknown	0.23		0.23		0.22		0.26	
High Degree of Customisation	0.3		0.35		0.32		0.3	
Age of Product	5.36	2.52	5.34	2.21	5.18	2.51	5.05	2.22
Share of Best Selling Products:								
- 30-60%	0.37		0.38		0.36		0.36	
- 60-80%	0.30		0.32		0.32		0.38	
- 80-100%	0.12		0.13		0.13		0.13	
Capital good	0.35		0.51		0.34		0.51	
Intermediate good / service	0.33		0.2		0.31		0.16	

Appendix D Regression Models

Table D-1:
Propensity of Internationalisation – Results using a Probit Model

	Whole Sample		UK		Germany	
	Number of obs = 528 LL = -258,2 chi ² (25) = 157,1 Pseudo R ² (¹) = 0,233 correct classified: 77,5 % max chance: 66,5 %		Number of obs = 350 LL = -159,8 chi ² (20) = 116,09 Pseudo R ² (¹) = 0,266 correct classified: 79,4 % max chance: 68,57 %		Number of obs = 178 LL = -93,07 chi ² (21) = 49,63 Pseudo R ² (¹) = 0,211 correct classified: 75,8 % max chance: 62,4 %	
	<i>Marginal</i>	<i>t</i>	<i>Marginal</i>	<i>t</i>	<i>Marginal</i>	<i>t</i>
	<i>Effects</i>		<i>Effects</i>		<i>Effects</i>	
West-Germany	0.2074	2.47 **				
East-Germany	0.0453	0.47			-0.2389	-2.53 **
ICT-Hardware	0.1533	2.49 **	0.1919	2.74 ***	0.0520	0.43
Engineering	0.2080	3.34 ***	0.2136	2.87 ***	0.1623	1.39
Bio/Med/Life	0.2029	2.77 ***	0.2050	2.49 **	0.1810	1.22
Other Industries	0.1436	2.43 **	0.1094	1.54	0.1921	1.69 *
Log(No. empl. start up)	0.1089	3.67 ***	0.0967	2.63 ***	0.1037	1.92 *
Log(Age)	0.2178	4.51 ***	0.2381	4.17 ***	0.1427	1.50
R&D occasionally	0.0055	0.08	-0.0193	-0.22	0.0228	0.17
R&D permanent	0.1206	1.58	0.0386	0.43	0.2383	1.69 *
R&D intensity	0.0027	1.69 *	0.0039	1.88 *	0.0012	0.43
Experience abroad	0.1145	2.32 **	0.0938	1.65 *	0.1464	1.50
Experience in MNC	0.1542	3.33 ***	0.1522	2.79 ***	0.1570	1.78 *
Education abroad	0.0461	0.65	0.1202	1.36	-0.0754	-0.62
Product technology UK						
New combin. of ex.tech	0.1670	2.38 **	0.1605	2.31 **		
New tech. devel. elsew.	0.1999	2.46 **	0.1869	2.35 **		
New tech.devel.Inhouse	0.1514	2.07 **	0.1371	1.80 *		
Product technology FRG						
New combin.of ex.tech	-0.0904	-0.76			-0.0775	-0.60
New tech. devel.elsew.	-0.2559	-2.05 **			-0.2271	-1.74 *
New tech.devel Inhouse	-0.0338	-0.34			-0.0262	-0.22
Intense product custom.	-0.1654	-3.32 ***	-0.2129	-3.49 ***	-0.0724	-0.79
Consumer good	-0.1618	-2.06 **	-0.1820	-2.09 **	-0.1332	-0.70
Ready to use product	-0.0968	-2.12 **	-0.0983	-1.80 **	-0.1159	-1.37
Shortage in competencies						
Sale/Marketing	-0.0393	-1.52	-0.0414	-1.40	-0.0305	-0.57
Production/R&D	-0.0099	-0.31	-0.0217	-0.57	-0.0036	-0.06

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

(¹) McFaddens R²

Base category = software firm without regular R&D activities selling “tried and tested technology”

Source: LBS/ZEW 1998

Table D-2:
Probability of International Sales
Using the Number of Market Entries as the Threshold in a Multinomial Logit Model

<i>Exogenous variables</i>	Number of obs = 528 Chi2(50) = 216.80 Log Likelihood=-409.15 Pseudo R ² =0.2095			
	less than three market entries		at least three market entries	
	<i>Coefficient</i>	<i>asym.t</i>	<i>Coefficient</i>	<i>asym.t</i>
Base category: No international sales				
West-Germany	-0.188	-0.24	1.765	3.43 ***
East-Germany	-1.060	-1.27	0.687	1.32
ICT-Hardware	0.549	1.18	0.904	2.48 **
Engineering	0.683	1.30	1.390	3.49 ***
Bio/Med/Life	1.090	1.82 *	1.285	2.67 ***
Other Industries	0.783	1.86 *	0.729	2.12
Log(No. employees start up)	0.219	1.04	0.687	4.18 ***
Log(Age)	0.863	2.62 ***	1.163	4.37 ***
R&D occasionally	-0.345	-0.74	0.367	0.86
R&D permanent	-0.351	-0.71	1.125	2.61 **
R&D intensity	0.015	1.39	0.014	1.56
Experience abroad	0.308	0.94	0.728	2.73 ***
Experience in MNC	0.740	2.36 **	0.800	3.18 ***
Education abroad	-0.123	-0.23	0.488	1.23
Product technology UK				
New combin.of exist. tech.	1.124	2.28 **	0.817	1.90 *
New tech. devel. Elsewhere	1.248	2.01 **	1.115	2.07 **
New tech. devel. In-house	0.812	1.54	0.841	1.95 **
Product technology FRG				
New combin.of exist. tech.	-0.051	-0.05	-0.684	-1.18
New tech devel. Elsewhere	0.317	0.37	-1.791	-2.77 ***
New tech. devel. In-house	0.550	0.63	-0.457	-0.88
Intense product customisation	-0.364	-1.14	-0.978	-3.73 ***
Consumer good	-0.590	-1.20	-0.866	-2.20 **
Ready to use product	-0.416	-1.35	-0.519	-2.10 **
Shortage in competencies				
Sale/Marketing	0.132	0.78	-0.330	-2.37 **
Production/R&D	-0.196	-0.90	0.007	0.04
Constant	-3.405	-3.80 ***	-4.752	-6.17 ***

* 10 % level of significance

** 5 % level of significance

*** 1 % level of significance

Table D-3:
Probability of International Sales Based on the Degree of Internationalisation as the Threshold
- in a Multinomial Logit Model -

Base category: No international sales		Number of obs = 528 Chi2(50) = 186.82 Log Likelihood=-439.91 Pseudo R ² =0.1751			
		less than 10% foreign sales		at least 10% foreign sales	
<i>Exogenous variables</i>	<i>Coefficient</i>	<i>z</i>	<i>Coefficient</i>	<i>z</i>	
West-Germany	1.276	2.219 **	1.159	2.254 **	
East-Germany	0.755	1.307	-0.168	-0.308	
ICT-Hardware	0.403	0.918	1.021	2.806 ***	
Engineering	0.809	1.692 *	1.440	3.589 ***	
Bio/Med/Life	0.618	1.046	1.532	3.175 ***	
Other Industries	0.440	1.095	0.927	2.682 ***	
Log(No. employees start up)	0.490	2.626 ***	0.580	3.567 ***	
Log(Age)	0.841	2.655 ***	1.182	4.494 ***	
R&D occasionally	0.025	0.052	0.064	0.156	
R&D permanent	0.430	0.891	0.690	1.670 *	
R&D intensity	0.012	1.192	0.015	1.694 *	
Experience abroad	0.446	1.388	0.667	2.536 **	
Experience in MNC	0.492	1.625	0.918	3.678 ***	
Education abroad	0.424	0.924	0.296	0.747	
Product technology UK					
New combin.of exist. tech.	0.680	1.364	1.022	2.439 **	
New tech.devel. Elsewhere	0.455	0.668	1.436	2.748 ***	
New tech.devel. In-house	0.455	0.886	0.925	2.182 **	
Product technology FRG					
New combin.of exist. tech.	-0.857	-1.233	-0.248	-0.415	
New tech.devel. elsewhere	-1.567	-2.057 **	-0.992	-1.566	
New tech.devel. Inhouse	-0.372	-0.640	-0.052	-0.097	
Intense product customisation	-0.543	-1.769	-0.873	-3.372 ***	
Consumer good	-0.529	-1.155	-0.904	-2.294 **	
Ready to use product	-0.659	-2.240 **	-0.417	-1.694 *	
Shortage in competencies					
Sale/Marketing	-0.158	-0.947	-0.195	-1.426	
Production/R&D	0.070	0.339	-0.106	-0.608	
Constant	-3.682	-4.250 ***	-4.511	-6.029 ***	

* 10 % level of significance

** 5 % level of significance

*** 1 % level of significance

Table D-4:
The Degree of Internationalisation (Share of Non-Domestic Revenues)
– OLS Regression Model –
(subsample of internationalisers only)

	TOTAL Number of obs=335 F(23,314)=7.48 Prob>F=0.0000 R-squared=0.2608		UK Number of obs=229 F(18,210)=7.32 Prob>F=0.0000 R-squared=0.2817		GERMANY Number of obs=106 F(19,86)=2.41 Prob>F=0.0031 R-squared=0.2529	
<i>int_sh</i>	<i>Coef.</i>	<i>t</i>	<i>Coef.</i>	<i>t</i>	<i>Coef.</i>	<i>t</i>
East-Germany	-17.274	-2.996 ***			-5.920	-0.968
West-Germany	-9.384	-2.486 **				
Log(No. employees at start up)	0.153	0.080	-2.380	-0.946	0.747	0.240
R&D intensity	0.256	2.317 **	0.364	2.622 ***	0.196	1.195
Years since first int.sales	3.019	4.623 ***	2.914	3.714 ***	3.580	3.042 ***
ICT-Hardware	5.535	1.129	6.821	1.150	3.083	0.349
Engineering	11.811	2.378 **	9.474	1.422	18.468	2.185 **
Bio/Med/Life	13.930	2.385 **	14.005	2.059 **	16.703	1.668 *
Other Industries	8.907	1.824 *	9.667	1.463	8.929	1.245
Internat. in Business Plan	15.543	4.735 ***	21.252	5.085 ***	4.957	0.942
International R&D co-operation prior to entry	14.581	3.146 ***	14.470	1.975 **	13.292	2.038 **
Product technology						
New combination of exist. tech	7.699	1.699 *	11.997	2.088 **	-7.097	-0.944
New tech. developed Elsewhere	11.192	1.984 **	14.435	2.001 **	-3.340	-0.378
New tech.developed In-house	3.562	0.842	3.936	0.714	-0.840	-0.122
Shortage in competencies						
Sale/Marketing	-1.667	-0.947	-2.127	-0.997	-0.314	-0.094
Production/R&D	-0.977	-0.393	-2.300	-0.748	0.076	0.019
Capital good	2.977	0.869	2.635	0.591	10.536	1.882 *
Intermediate good	-1.195	-0.321	2.980	0.666	-10.001	-1.689 *
VC at start-up	9.470	1.755 *	8.382	1.499	26.262	1.914 *
Public grant at start-up	-0.636	-0.171	-0.440	-0.082	2.418	0.467
Constant	-6.441	-0.939	-11.599	-1.344	-11.640	-1.138

* 10 % level of significance

** 5 % level of significance

*** 1 % level of significance

Table D-5:
The Degree of Internationalisation (Share of Non-Domestic Revenues)
- Generalised Tobit Model -
(Entire Sample of Internationalisers and Domestic Firms)

	TOTAL		UK		GERMANY	
	Number of obs = 520		Number of obs = 345		Number of obs = 175	
	LL = - 1680.12		LL = - 1155.7		LL = -509.17	
	chi2(18) = 390.42		chi2(17) = 265.16		chi2(18) = 137.31	
	Prob > chi2 = 0.0000		Prob > chi2 = 0.0000		Prob > chi2 = 0.0000	
	Pseudo R2 = 0.104		Pseudo R2 = 0.1029		Pseudo R2 = 0.1189	
<i>int_sh</i>	<i>Coef.</i>	<i>t</i>	<i>Coef.</i>	<i>t</i>	<i>Coef.</i>	<i>t</i>
East-Germany	-13.536	-2.414 **			-5.334	-0.991
West-Germany	-6.662	-1.780 *				
Log(No. employees start up)	2.239	1.230	1.288	0.531	1.119	0.419
R&D intensity	0.405	16.852 ***	0.520	4.137 ***	0.228	1.703 *
Years since first int. sales	9.049	4.267 ***	9.175	13.945 ***	8.512	9.085 ***
ICT-Hardware	10.694	2.361 **	12.746	2.229 **	6.112	0.871
Engineering	19.343	4.094 ***	18.670	3.025 ***	22.118	3.194 ***
Bio/Med/Life	18.989	3.440 ***	19.290	2.758 ***	20.985	2.489 **
Other Industries	14.152	3.064 ***	17.405	2.804 ***	8.538	1.326
Product technology						
New combin.of exist. tech.	11.103	2.546 **	19.322	3.416 ***	-9.561	-1.370
New tech. devel. Elsewhere	12.289	2.325 **	22.995	3.282 ***	-8.728	-1.092
New tech. devel. In-house	7.886	1.879 *	12.361	2.152 **	0.286	0.049
Shortage in competencies						
Sale/Marketing	-3.703	-2.199 **	-4.567	-2.226 **	-0.747	-0.261
Production/R&D	1.061	0.475	1.180	0.423	0.255	0.074
Capital good	3.209	1.007	1.342	0.323	10.890	2.280 *
Intermediate good	1.056	0.290	4.197	0.918	-9.405	-1.595
VC at start up	13.771	2.678 ***	15.863	2.667 ***	0.961	0.088
Public grant at start up	2.935	0.776	4.216	0.789	4.569	0.930
Constant	-45.935	-7.685 ***	-55.079	-6.960 ***	-36.510	-4.257 ***

* 10 % level of significance

** 5 % level of significance

*** 1 % level of significance

**Table D-6:
Hazard Function Results for the Timing of Internationalisation**

Exogenous variables	Cox regression -		Exponential regression		Weibull regression	
	Coefficient	Asymptotic t-values	Coefficient	Asymptotic t-values	Coefficient	Asymptotic t-values
West-Germany	0.6856	2.96	0.6841	2.95	0.7735	2.69
East-Germany	0.3053	1.23	0.3188	1.29	0.4122	1.38
ICT-Hardware	0.2580	1.70	0.2650	1.74	0.2858	1.57
Engineering	0.3864	2.50	0.3865	2.50	0.4230	2.26
Bio/Med/Life	0.4610	2.81	0.4587	2.78	0.5270	2.59
Other Industries	0.2333	1.57	0.2317	1.55	0.2441	1.37
Log(No. employees start up)	0.2002	3.11	0.1973	3.09	0.2239	2.79
R&D occasionally	0.4042	1.87	0.4095	1.90	0.5164	2.08
R&D permanent	0.4875	2.25	0.4853	2.24	0.5366	2.14
R&D intensity	-0.0003	-0.17	-0.0001	-0.06	0.0001	0.03
Product technology UK						
New combin. of exist. tech	0.3006	1.59	0.3088	1.63	0.3267	1.46
New tech. devel. Elsewhere	0.4448	2.05	0.4541	2.11	0.5017	1.95
New tech. devel. In-house	0.3550	1.91	0.3614	1.94	0.3765	1.70
Product technology FRG						
New combin. of exist. tech	-0.0836	-0.34	-0.0784	-0.32	-0.1026	-0.33
New tech. devel. Elsewhere	-0.4030	-1.32	-0.4052	-1.32	-0.4585	-1.28
New tech. devel. In-house	-0.1532	-0.67	-0.1525	-0.66	-0.2141	-0.74
Experience abroad	0.2717	2.53	0.2753	2.57	0.3227	2.42
Experience in MNC	0.4379	4.38	0.4500	4.54	0.5531	4.49
Education abroad	0.0544	0.38	0.0504	0.35	0.0526	0.29
Shortage in competencies						
Sale/Marketing	-0.1006	-1.85	-0.0939	-1.73	-0.1050	-1.58
Production/R&D	-0.0790	-1.07	-0.0821	-1.12	-0.1142	-1.30
Intense product customisation	-0.4318	-3.59	-0.4317	-3.57	-0.5234	-3.57
Consumer good	-0.2168	-1.29	-0.2196	-1.31	-0.2139	-1.08
Ready to use product	-0.2662	-2.63	-0.2692	-2.67	-0.3263	-2.65
Shape-Parameter						
log (α)					0.3565	10.72
α					1.43	
<i>Summary statistics:</i>						
No of observations	521		521		521	
χ^2 against constant only	131.13		137.78		123.09	
Log. Likelihood	-1993.15		-606.24		-576.31	

Table D-7:
Productivity and International Business Activities

Endogenous Variable: Labour Productivity	Model (1) IV estimation Full Model		Model (2) IV estimation Without industry effects		Model (3) Weighted IV Without industry effects		Model (4) LAD estimation Without industry effects	
	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
West Germany	0.802	2.33***	0.583	3.32***	0.506	3.08***	0.490	3.04***
East Germany	0.716	2.02**	0.479	2.49***	0.417	2.37***	0.342	1.99**
ICT-Hardware	0.241	2.17***	-	-	-	-	-	-
Engineering	0.106	1.17	-	-	-	-	-	-
Bio/Med/Life	0.190	1.01	-	-	-	-	-	-
Other Industries	0.108	0.82	-	-	-	-	-	-
log (Capital intensity)	0.642	1.94**	0.430	2.60***	0.314	2.02***	0.349	2.28***
log (R&D intensity)	0.120	2.80***	0.119	2.91***	0.161	4.78***	0.148	4.43***
Dummy: R&D>0	0.005	-0.06	-0.004	-0.05	-0.063	-0.80	0.013	0.16
log (non R&D employment)	0.174	-2.60***	-0.154	-2.93***	-0.081	-2.01***	-0.108	-2.76***
International Sales	0.410	2.92***	0.485	3.64***	0.518	4.40***	0.386	3.32***
Venture Capital	0.351	2.08***	0.333	1.92***	0.419	2.42***	0.416	2.47***
Public Grants	0.108	-0.52	0.001	0.01	-0.170	-1.07	-0.228	-1.45
Constant	9.735	8.72***	10.481	18.85***	10.82 4	20.60***	10.781	20.90***
Industries: F(4,506)/p-value	1.50	0.20	-	-	-	-	-	-
<i>Summary statistics:</i>								
- Number of observations		520		520		520		520
- R ² / R ² / Pseudo- R ²		0.167		0.156		-		0.110
- F(13,506) / F(9,510)		9.08		12.18		12.96		-
<i>Specification Tests</i>								
Heteroscedasticity test ¹⁾ $\chi^2(1) / p$ -value	0.35	0.55	0.36	0.54	-	-	-	-
Functional form test ²⁾ F(18,488) / p-value	1.51	0.08	1.47	0.10	-	-	-	-

* 10 % level of significance

** 5 % level of significance

*** 1 % level of significance

Note: 1) Cook-Weisberg test using powers of the fitted values

2) Ramsey Reset test using powers of the exogenous variables

Table D-8:
Sales and Employment Growth Regressions – Instrumental Variable Estimates

Exogenous variables	Sales Growth		Employment Growth	
	Coeff.	Asy. t- value*	Coeff.	Asy. t- value*
West-Germany	-0.061	-1.98	-0.020	-1.09
East-Germany	0.037	0.68	-0.011	-0.43
log (Age)	-0.406	-6.30	-0.229	-6.40
log(Sales first financial year)	-0.132	-7.55	-0.121	-12.46
Number of Founders:				
2-3	0.045	1.55	0.009	0.53
3-4	0.120	2.93	0.036	1.90
5 and more	0.190	2.29	0.031	0.90
Shortage in competencies:				
Sale/Marketing	0.010	0.67	-0.001	-0.08
Production/R&D	0.018	1.05	0.014	1.36
Permanent R&D	0.064	2.35	0.022	1.43
Window of Opportunity:				
larger than 1 year	-0.014	-1.43	-0.031	-1.64
not known	-0.038	-1.94	-0.049	-2.27
log (Age of Product)	-0.054	-1.89	Not included	
Share of Best Selling Product:			Not included	
30-60%	0.053	1.65	Not included	
60-80%	0.076	2.06	Not included	
80-100%	0.116	2.23	Not included	
Venture Capital	0.056	0.67	0.044	0.97
Public Grants	0.024	0.29	0.052	1.30
International Sales	0.291	2.87	0.080	1.41
Constant	1.119	10.33	0.784	12.84
Summary statistics:				
Number of observations		503		528
R ²		0.25		0.36
Specification Tests				
Functional Form Reset Test 1				
F(24, 459) / p-value		1.14 / 0.30		0.60 / 0.92
Heteroscedasticity 2				
χ^2 / p-value		131.15 / 0.00		50.10 / 0.00

* based on heteroscedasticity robust standard errors

1) Cook-Weisberg tst using powers of the exogenous variables
 Ramsey Reset test using powers of the exogenous variables

Table D-9:
Probit-Regression Models for Generating Instruments

Variables	Model 1 International Sales		Model 2 Venture Capital		Model 3 Public Grants	
	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
West-Germany	0,161	1,073	-0,158	-0,758	-0,204	-1,210
East-Germany	-0,456	-2,236 ***	0,303	1,102	0,733	3,637 ***
ICT-Hardware	0,278	1,569	-0,045	-0,192	0,506	2,585 ***
Engineering	0,362	1,876 **	-0,605	-2,397 ***	0,385	1,852 **
Bio/Med/Life	0,511	2,319 ***	0,311	1,112	0,468	1,810 **
Other Industries	0,037	0,231	-0,397	-1,722 *	0,281	1,426
Startup Year:						
- 90/92	-0,247	-1,703 **	-0,182	-0,899	-0,396	-2,323 ***
- 93/96	-1,228	-7,355 ***	-0,237	-1,089	-0,294	-1,639 *
Number of Employees at start-up	0,083	1,059	0,048	0,499	0,044	0,444
Number of Founders:						
- 2-3	-0,052	-0,354	-	-	-0,325	-1,992 **
- 3-4	0,321	1,860 **	-	-	-0,351	-1,790 **
- 5 and more	0,086	0,308	-	-	-0,536	-1,602 *
Experience abroad	0,252	1,909 **	-	-	-	-
Experience in MNC	0,350	2,769 ***	-	-	-	-
Education abroad	0,054	0,301	-	-	-	-
Venture Capital at start-up			1,795	8,040 ***	-	-
Public Subsidy at start-up			-	-	1,268	8,113 ***
Shortage in competencies at start-up:						
- Sale/Marketing	-0,021	-0,312	-0,178	-1,781 **	0,180	2,216 ***
- Production/R&D	-0,066	-0,738	-0,040	-0,363	0,049	0,517
Constant	-0,271	-1,413	-1,361	-5,585	-1,074	-5,001
Summary statistics:						
- Number of observations		528		528		528
- McFaddens Pseudo R ²		0,1600		0,2350		0,2079
- Wald χ^2 against model with constant only		102,06		79,46		110,73

* 10 % level of significance

** 5 % level of significance

*** 1 % level of significance