

Funding TECHNOLOGY

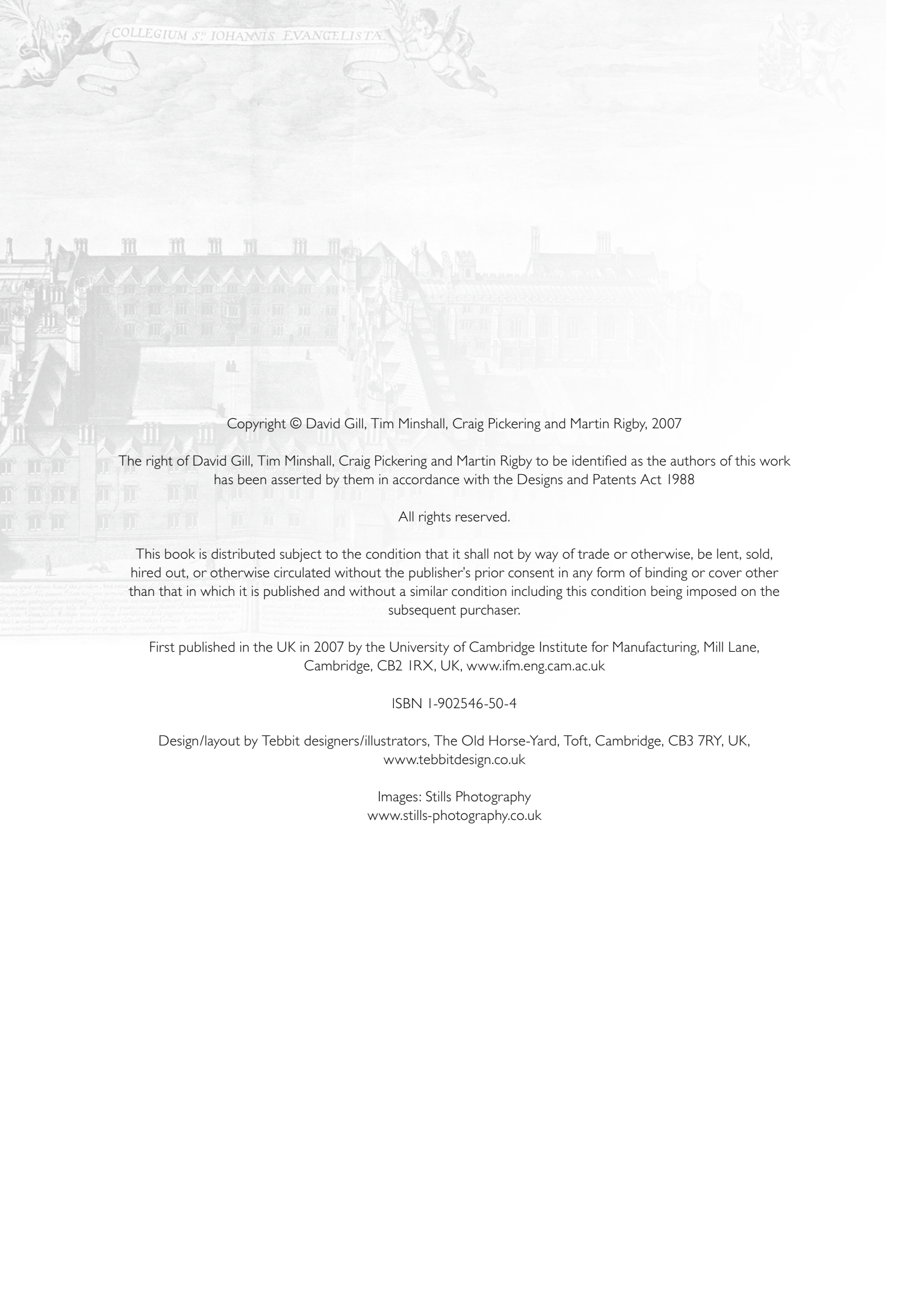
Britain Forty Years On

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With a foreword by Sir David Cooksey

January 2007



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Abstract

"The Britain that will be forged in the white heat of this [scientific and technological] revolution will have no place for restrictive practices and outdated measures on either side of industry."

Harold Wilson (1963)¹

"To let. A valuable site at the cross-roads of the world. At present on offer to European clients. Outlying portions of the estate already disposed of to sitting tenants. Of some historical and period interest. Some alterations and improvements necessary."

Alan Bennett (1969) *Forty Years On*

"It is incumbent on Massachusetts [...] to do a much better job of technology auditing and forecasting. We need to collaborate more effectively and develop a technology road map that looks five or ten years down the line [...] we run the risk of turning into Cambridge, England: we'll have isolated clusters of the very best university research and a small number of R&D firms but not downstream production, service and support jobs that make a vibrant economy. We'll create all the new ideas - but others will get too much of the benefit."

Prof Michael Best, UMass Lowell Center for Industrial Competitiveness²

Half empty or half full? Forty years after 'white heat' and 'technological revolution' entered the language as idioms, many observers wonder if, for British innovation, the whole is less than the sum of the parts. Despite considerable progress in specific areas (Britain has the world's second largest share of private equity and is a leader in business incubation), momentum is still lacking in the successful exploitation of new ideas. If other Western European competitors have fared worse in confronting one of the fundamental challenges of developed economies, there is no room for complacency, as other more nimble entrants across the globe start to leapfrog a Britain which has taken most of the post-war period to shed its historical baggage.

The world's first modern industrial revolution began in Britain in the 18th century, with coal-fired steam engines enabling the mass production of cloth and steel. Urbanisation followed and trade flourished, as finished goods paid for both raw materials and imperial expansion. First-mover advantage reached its visible apogee with the Great Exhibition of 1851. But by the end of the 19th century other countries—the United States, Germany—had caught up either in absolute terms or in output per worker. After the Second World War, historical leadership turned into a handicap as Britain was locked into old manufacturing industries without the resources to renew or modernise its ageing plants. As former US Secretary of State Dean Acheson (1893–1971) put it, "Great Britain has lost an empire and has not yet found a role"³.

Until the 1980s, much of the British élite saw its role as

(in the words of one Permanent Secretary⁴) managing the decline⁵. After a decade or more of macroeconomic, supply-side and social reform leading to stable growth and reasonable industrial relations, Britain was once again in the vanguard (behind the US) of a new industrial revolution: the commercial exploitation of research in engineering, electronics, software and biology. In many ways, the Britain of the early 21st century is well-placed to take advantage of the second industrial revolution: a long tradition of scientific discovery and inventiveness (television, the hovercraft, penicillin), sophisticated professional services and financial markets, respected universities, the English language itself.

But Britain's comparative advantage in the commercialisation of new technologies is fragile. The UK economy suffers from specific weaknesses that are structural rather than cyclical. One notable weakness is the **persistent lack of risk capital**. Although the headline figures for European venture capital investment regularly

4 "The former head of the foreign service Sir Patrick Wright— a modest and unassuming man— has explained that diplomats were 'in the business of managing decline and adjusting to Britain's position after the war.'" Sampson (2004) p133.

5 "[...] commentators spoke wearily of the so-called 'British disease'. By this they meant an affliction of restrictive practices, low productivity, trade union militancy, penal taxes, poor profits, low investment - in short economic decline. And hardly less corrosive was the mentality which underlay, and which was itself encouraged by that decline. To put it simply, there was a resigned acceptance that Britain was finished. This discouraged some politicians on the Right, who felt that damage limitation was the only sensible strategy, that managing decline made best sense." Convocation address by Lady Thatcher at Hofstra University, New York, 27 March 2000. <http://www.margareththatcher.org>, accessed on 18 June 2006.

1 Speech to Labour Party conference, 1 October 1963.

2 Mass Insight Corporation (2004).

3 Speech at West Point Military Academy, 1962.



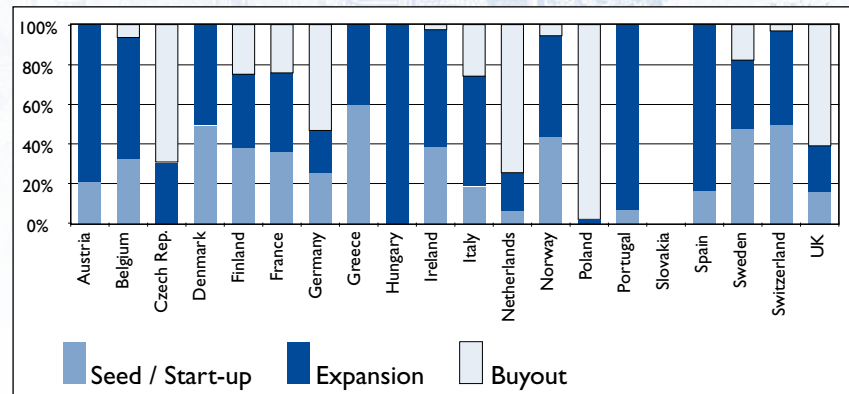
show that the UK accounts for between a third and a half of the total market, more detailed analysis reveals that most funding is directed at later-stage transactions (such as management buy-outs or de-listings); relatively little capital reaches early-stage, technology-specific firms. Further down the path of the 'new industrial revolution' than most of its European competitors, Britain needs a far higher proportion of risk capital than (say) France or Germany, yet the evidence suggests that we are providing less.

Mitigating circumstances exist for the relative dearth of early-stage technology funding. Despite a marked increase in the professionalism of British management, the relatively short span of the current commercial revival means that **few serial entrepreneurs** are available to take new ideas to market and bolster teams of keen but inexperienced technology managers. Marketing in particular – or more specifically sales management – remains weak. Many investors are frustrated by the continuing belief among first-time entrepreneurs that the market will beat a path to their door if they build a better mousetrap; new technology firms are often poor at integrating their products with those of existing market leaders.

The British **commercial banking sector** is among the most efficient and profitable in the world⁶, but its reliance on established industries or consumer credit and its inability to come to grips with intangible assets resembles the Maginot Line in the 1930s: superbly built for fighting the previous war. Nor is European competition likely to change domestic attitudes⁷, though modest incursions by specialist US operations may yet act as yeast in the dough⁸.

The problem of exploiting research commercially is compounded by the **decline of manufacturing** in the UK. In theory, Britain should be able to profit by acting as a centre of research and development and sub-contracting manufacturing overseas, and many uncompetitive plants were shut in the 1980s and 1990s. But keeping a 'high

Figure A: Balance of venture capital (seed), venture capital (expansion) and buyout funding as % of all private equity for 2004



Source: PricewaterhouseCoopers (2005) cited in Livesey et al. (2006).

value⁹ manufacturing capability allows more of the value chain to be retained, and this is proving difficult. Although manufacturing has grown in terms of absolute output since the 1980s, it has declined in relative terms from some 30% in 1973 to 17% in 2003 as services and new knowledge-based sectors have grown. The cost pressures favouring off-shore manufacturing mean that much tacit knowledge is lost in new product development and that not all the potential value in the supply chain is captured. Both know-how and intellectual property may leak.

Following intervention by the International Monetary Fund in 1976, there has been a tendency for Britain to behave like a corporation restructuring itself through repeated cost-cutting. The unintended consequence of this cost control has been **sustained cut-backs in investment**.

When discussing our poor performance at converting research outputs into products and services it is always stressed that at least we are producing world-class research. Indeed, British academics have fared well in international research citation indices, giving one of the highest returns per dollar invested. But research shows that the numerator of return has been stretched as far as it will go and many question whether it is even too late to increase the denominator of investment¹⁰: numerous bright students, who once would have remained at university as academics, left in the 1990s for careers unrelated to science.

At the national level, **universities suffered real cuts** as student numbers trebled from 1985 to 2005 with no

6 "In just six months UK banks [...] made nearly £100 of profit for every man, woman and child in Britain." The Times, London, 7 August 2004 p48.

7 "One of the most attractive growth opportunities for highly profitable, capital rich European banks is that of international expansion. The EU's banks produce around a quarter of global banking profits (5 of the top 25 global banks by market capitalisation are UK banks and the rest of the EU has 7). Yet outside HSBC there is perhaps no European retail bank competing across the world's markets – or indeed even across Europe." John Tiner, Chief Executive, Financial Services Authority, IIF Spring Conference, Madrid 2005.

8 "U.K.-based technology companies do not currently have many options when it comes to debt financing and our goal is to offer access to our vast network of business connections and debt sources in the U.S., spurring additional growth opportunities for British entrepreneurs." Silicon Valley Bank press release on opening its UK subsidiary, 16 September 2004.

9 This term has emerged in policy circles to describe a somewhat hazy concept – but one which is being actively pushed by Government. A recent briefing paper summed up the essence of high-value manufacturing firms from a national economic perspective as those which have strong financial performance, are strategically important and have a positive social impact. See Livesey (2006).

10 Livesey et al. (2006)



increase in funding for teaching. British universities, many once at least as highly rated as leading US schools and an integral component of the knowledge economy, may not be able to recover in terms of equipment and morale despite recent government investment, especially in the sciences. Have policy makers taken account sufficiently of **Baumol's cost disease**? This institutional affliction, named after the Princeton and New York University economist William Baumol, suggests that unlike manufacturing, where increased output often reduces unit costs, educating students is a labour-intensive process, where costs will always go up. Hiring and retaining good faculty, purchasing the latest technology, offering worthwhile academic and extracurricular programmes, cannot be offset by increased productivity¹¹.

Similar considerations apply to recent investment in tangible infrastructure such as transport, the quality of which may partly explain Britain's perennial low productivity when compared to the US or France.

This focus on short-term savings at the cost of long-term investment is particularly evident in the private sector's approach to research and development. Against its OECD competitors, the UK's investment performance is regularly only average—fifth behind Japan, the US, Germany and France¹²—which undermines the competitive advantage of an economy increasingly reliant on innovation. Further analysis of the research figures shows that even

this middling position is only secured through heavy investment in a very few sectors, such as defence and pharmaceuticals. Much of the defence sector is arguably an extension of government, and pharmaceutical research is increasingly concentrated in fewer centres around the world. The EU has set a target of 3% for R&D as a percentage of GDP by 2010. The UK has set a target for itself of 2.5% to be reached by 2014, but even this may be a struggle for the UK as it "... is the only OECD country for which R&D intensity fell over both the 1980s and 1990s"¹³.

Britain has made significant progress in specific areas of innovation over the forty years since it first purported to embark on a technological revolution. It cannot let another forty years pass by before making the component parts of the knowledge economy work more effectively together: 'some alterations and improvements are necessary'.

11 Baumol and Towse (1997)

12 <http://www.esrc.ac.uk/ESRCInfoCentre/facts/UK/>

13 OECD (2005).



Conclusions and Recommendations

Policy

- Policy makers should recognise both that in commercialising technology the UK is two economic cycles behind the US and that its pace of change must increase: the UK cannot be compared directly with the US and may not be able to copy its example in all aspects of the 'golden chain of innovation'.
- Detailed research is required to establish the overall size of the tech market (SIC codes are insufficient), its dynamics compared with non-tech SMEs (growth, closure, exports, employment), its potential for the UK economy when compared with EU and 'new' competitors such as India or Singapore.
- The UK must recognise that on its own it is rarely if ever sufficiently large as a market – hence the imperative to build international relations for tech firms from the outset.
- European solutions to the problem of scale have proved elusive for 40 years or longer. Policy maker should move on from the Lisbon Agenda to face up to the challenge of India and China.

Risk Capital

- The UK must find a means of making early-stage venture capital for technology companies more attractive as an asset class for investors such as pension funds. A detailed review of the sector, comparing its practices with the successful US and Israeli industries, is required.
- A clear understanding of the difference between venture capital and private equity must be established in policy circles and in the preparation of statistics.

Management

- Improving the fundamental marketing skills of tech managers is essential, as is accessing skills in production (moving from R&D to customer solutions).
- More top students in science, engineering and management should be sent to experience Silicon Valley's scale and power.
- More efforts should be made to retain overseas students in the UK reading for higher degrees in science and engineering once their studies are complete.

Universities

- After a decade of mixed policy agendas, sober rethinking is required of the role of universities: what are they for, how should they be funded, who benefits and what are the diminishing returns of education.ⁱ
- The UK government views universities as playing a key role in supporting innovation – as providers of the world-class research that feeds IP into the innovation system; as providers of people with the skills to bring ideas to market; but also as active generators of commercial value from their IP. Recognition is needed that not all universities are able to

operate in all three areas, and that knowledge transfer is increasingly a people-centric activity.

- Following years of neglect, the government realises that significant investment is needed to ensure that the UK's science base remains world-class. Investment must be sustained, especially in the light of full economic costing modelsⁱⁱ, to maintain our world-class position in the face of increased competition from China and India.
- Blurring of the boundaries between research and commercialisation may present challenges in the future, as exemplified by the current debate in the US around royalty-free use of patented IP by universities. Care is needed to ensure that an over-emphasis on short term returns does not drive companies away from universities.
- There would be benefit in more detailed analysis of the real impact of HEIF funding streams and the various precursor schemes.

Government

- The role of government is to enable (e.g. via tax incentives), to provide infrastructure (roads, schools), to inform debate, but not to act as an investor in early-stage technology. Market intervention to push up VC as a proportion of GDP may have limited effect.
- Government should analyse further and address the R&D/ investment underspend in the private sector but this should be done while understanding the real role of R&D in a knowledge-based economy. There is some evidence to show that increasing R&D spend as a proportion of GDP above 1.5% has limited impact.
- The nature of innovation is becoming more open in many sectors, and government support needs to adapt to reflect this change.
- Taxation, generally low in terms of capital gains, must be simplified.
- Further study is required of the issues relating to high value manufacturing, including its definition and sustainability in the absence of a broader manufacturing base.
- The UK government should consider the impact of the National Innovation Act in the US and the suitability of an equivalent for the UK.
- Regional development leads to fragmentation of impact and duplication of effort. The UK cannot sustain more than a handful (perhaps three or four) major centres of technological innovation. Greater coordination of planning is required to ensure investment decisions maximise scientific and commercial effectiveness.ⁱⁱⁱ

ii All UK universities are required to implement full economic costing in their research activities with a view to ensuring the appropriate recovery of the 'real' costs of managing research grants and contracts.

iii Planning permission was refused in 1999 for a 40,000m² development at Hinxton Hall to house the Human Genome Project on the grounds of scale (25,000m² would have been acceptable).

i Brown and Hesketh (2004).



Foreword

"[...] the seventeenth regular meeting of the National Economic Development Council (hereinafter referred to as 'Neddy') [...] held on 4th December 1963, on the fifteenth floor of the Vickers building on Milbank overlooking the Thames, witnessed the first (and unsuccessful) attempt in recent years to secure an agreed incomes policy [...] it represented a moment of truth in the examination of the forces playing upon the modern British economy – or indeed of any modern economy. It represented the, somewhat belated, recognition that the Age of Miracles was over."

Michael Shanks¹⁴

"The state supports R&D because it has a positive spillover effect. R&D benefits the entire economy, far beyond the specific company. The analogy used by economists is of a bee flying from flower to flower and sipping, while pollinating the flowers. No one plans the spillover effect, but it helps the economy."

Dr Carmel Vernia, former Israeli Chief Scientist (2001)¹⁵

"China and India alone graduate 6.4 million from college each year and over 950,000 engineers. The United States turns out 1.3 million college graduates and 70,000 engineers. We live in a global society, and by spurring research and innovation in the U.S., we are also insuring that our companies stay competitive internationally and prosper domestically."

Senator Richard Lugar, in support of the US National Innovation Act (2005)¹⁶

This report comes at a critical juncture. The age of economic miracles, if it ever existed, is indeed over. At various points in recent decades, Britain has undertaken a debate on its economic future in the face of international competition. During the 1960s, the dominant approach was to rely on the wisdom of central planning from Whitehall in deciding which technologies to pursue, and how. As this model unravelled, market-oriented solutions were preferred. On the whole, market solutions have been far more effective than government decisions, but there is still an important role for government to play—not least because gaps remain in the provision of funding for promising businesses at early-stages, especially those in technology sectors.

Government can and should act as an enabler—a provider of both a regulatory framework and a contributor to informed debate and co-operation. For instance, I was pleased to serve as the first chairman of the Small Business Investment Taskforce as its creation demonstrated recognition within government of the need to foster an environment in which small businesses are able to access the right type of advice and investment. The Taskforce contributed to this aim through initiatives such as the establishment of Regional Venture Capital Funds and Community

Development Funds. More recently, government began to implement the recommendation of the UK Clinical Research Collaboration Industry Reference Group, of which I am chairman, to reverse the decline in clinical research and clinical trials activity that has occurred in the UK over the last few.

When I first set up Advent Venture Partners in 1981, the UK hosted hardly any domestic venture funds. By 1984, when I was the first chairman of the British Venture Capital Association, total amounts invested in the UK amounted to some £250m. It was not until the end of the 1980s and into the 1990s that annual investment by BVCA members regularly topped £1,000m. In each of the past two years it has exceeded £20,000m. However, as I found at the Small Business Investment Task Force, it still appears that there is an investment gap in the range of £500,000 to £3m as many practitioners move upscale in terms of the investments they make. Our collective future depends on the success of innovative small firms with the capacity to become world leaders. This report shows how they operate and how their performance can be improved further.

Sir David Cooksey
Chairman, Advent Venture Partners LLP
Chairman, European Venture Capital Association

¹⁴ Shanks (1967).

¹⁵ Gill et al. (2002) p33.

¹⁶ As quoted at: <http://lugar.senate.gov/pressapp/record.cfm?id=249810>. Information on research underpinning the Act itself can be found at: <http://innovateamerica.org/webscr/report.asp>.



Preface

“Average growth rates for about one and a half millennia before the Industrial Revolution are estimated to have been approximately zero [...] In contrast, in the past 150 years, per capita incomes in a free-market economy have risen by amounts ranging from several hundred to several thousand percent.”

William Baumol¹⁷

“Though *George Brown* is a great success, the division of power between the Treasury and the DEA is a development for which we are having to pay a heavy price in divided authority and dissension in central planning. I have some grave doubts about the new Ministry of Technology under Frank Cousins and Lord Snow.”

R H S Crossman¹⁸

The aim of this report is to act as a stimulus for debate on how Britain can improve its ability to exploit new technology commercially and so support sustained economic growth in the face of intensifying international competition. The report begins with a detailed initial chapter that sets the historical context for this debate. Subsequent chapters then focus on a series of specific themes relating to innovation in the UK, structured and interpreted by the differing perspectives of the individual lead authors.

We do not report substantial new research findings but rather attempt to combine a synthesis of the substantial volume of research that has been generated on this topic in recent years with numerous interviews with leading practitioners in the exploitation of new technology¹⁹. The interviews were conducted from mid-2004 to mid-2006. Interviews were supplemented by desk research including reviews of the large number of reports produced in this period relating to innovation in the UK. We have tapped the professional experience of the individual authors, all of whom have been involved with innovation for some considerable time. We were also able to draw upon a number of related research projects that the authors were involved in during the production of this report.

Our earlier studies consisted of analyses of the innovation systems of other jurisdictions, partly to enable lessons to be distilled for the benefit of the UK. The current report has been more difficult to assemble in that the comparator of a foreign country has been removed. In addition, the UK market has not been short in the past year or so of detailed studies of the state of science and its commercialisation; the challenge has been to see the wood behind such former trees. In seeking to present the wider picture, we have benefited from discussions with innovation experts in other countries familiar with the UK.

The conceptual framework of this report inevitably draws heavily on the previous studies in the *Funding Technology* series²⁰. The public policy recommendations draw on *The Frontiers of Innovation: Wealth Creation from Science, Engineering and Technology in the UK*, the report of a group chaired by Sir Peter Williams, of which one of the current authors formed part; and on *Investigating the technology-based innovation gap for the United Kingdom*, a report to the Design Council in June 2006, to which another of the current authors contributed.

The research behind this report was once again undertaken thanks to generous support from the Gatsby Charitable Foundation. We are grateful to numerous experts, in the UK and beyond, who have assisted our enquiry and commented on the manuscript in draft. All remaining errors are the authors' own. Our professional bias risks giving *Britain Forty Years On* a flavour dominated by the ‘golden triangle’ of the south and east of England despite the spirited attempts of our interviewees in Scotland and Yorkshire to correct our shortcomings.

Preparing the report has taken nearly two years; though this was not by design, the extended period has enabled, we trust, a more considered view to be taken of the extensive developments affecting the funding of technology over the past ten years; the owl of Minerva spreads her wings only with the falling of dusk. Where possible, data have been included up to the end of June 2006.

The opinions expressed in this report are those of the authors alone and do not necessarily reflect those of the organisations for which they work or those that have provided support, guidance and advice in its preparation.

Cambridge, Michaelmas
29th September, 2006

¹⁷ Baumol (2002) p3.

¹⁸ Crossman (1979), entry for 3rd January 1965.

¹⁹ Full list of interviewees and commentators given in Appendix I.

²⁰ All reports in this series can be downloaded from www.fundingtechnology.org

Historical and Economic Context

"The role of government is to build real infrastructure, which most of the Western world has not realised or managed. Contrast Singapore: with limited resources in a hostile environment, its government is run like a management team, with ministers having annual objectives."

Former Israeli Chief Scientist (2001)²¹

"My companion [a future Governor of the Bank of England] recalled the parallel with the Wimbledon Tennis Championships: held in Britain, staffed by locals, dominated by foreigners but still generating bags of prestige and money for the UK. The City would be the same: safe as Europe's financial capital and a strong environment in which Britain's investment bankers could work. I disagreed, preferring the example of manufacturing, where the failure of British firms has left the UK without control of strategic industries or employment."

Philip Augar²²

"I sit on a man's back, choking him and making him carry me, and yet assure myself and others that I am very sorry for him and wish to ease his lot by all possible means – except by getting off his back."

Leo Tolstoy²³

Introduction

- 1.1 Over the past 40 years, numerous policy initiatives in Britain have sought to encourage the growth of small firms in general and those exploiting new technology in particular. However, it is not clear that 'enterprise' and 'innovation' have taken root in Britain as a result. These policies have now been tested against a background of increased macro-economic stability, with the last recession and sterling crisis both more than a decade behind us. So the experience we have of structural changes can be assessed mainly with reference to the various policies' own merits, without having to separate out unduly the noise created by high inflation and/or recession.
- 1.3 Not as inspiring as President Kennedy's pledge to put a man on the moon before the end of the decade (responding to the challenge of Sputnik in 1957 and the first manned orbit of earth by Major Yuri Gagarin on 12 April 1961) in his congressional address on 25 May 1961, Wilson's phrase nevertheless stuck. But the reality over the next four decades proved less straightforward. As Bernard Levin put it:

"In the cold light of the decade's end the speech does not make particularly impressive reading. For one thing, too many of the phrases which set the conference on a roar have since become not merely clichés ('... the conscious, planned, purposive use of scientific progress ...'). For another, the promises in it were belied as rapidly and completely as Wilson's other promises."²⁵

Technological Revolutions

- 1.2 In a speech to the Labour Party conference little more than a year before he became Prime Minister, Harold Wilson memorably referred to a different future for the country:
- "[...] the Britain that will be forged in the white heat of [the scientific and technological] revolution will have no place for restrictive practices and outdated measures on either side of industry."²⁴*
- 1.4 Wilson's speech-writer, Anthony Wedgwood-Benn, was appointed Minister for Technology in 1966, three years after Wilson's 'white heat' speech. A recurring theme of the post-war years begins to emerge: the blurring of economic and social policy aimed at the exploitation of scientific research:

"At this stage, Benn saw socialism as both a by-product from scientific development as well as being an aid to the scientific process itself."²⁶

²¹ Gill *et al.* (2002) p39.

²² Augar (2000) p3.

²³ Tolstoy (1886).

²⁴ Speech to Labour Party Conference, 1 October 1963.

²⁵ Levin (1970) p226.

²⁶ <http://labhist.tripod.com/tbenn.htm>, accessed on 18 June 2006/

1.5 A key focus for industrial policy during Benn's period in office was the formation of large, strong companies able to combat the power of established US and emerging Japanese corporations. The two most visible consequences of this strategy were, first, the creation of ICL through the amalgamation of numerous small electronics companies as a putative British alternative to IBM as a computer manufacturer; and, secondly, Anglo-French co-operation in the production of Concorde, the only supersonic airplane used by commercial carriers. However, ICL did not become IBM's rival; it was bought in 1990 by Fujitsu of Japan and is now solely a services company. In total, 14 Concorde were sold (to Air France and British Airways, then both national 'flag-carriers') and hundreds of millions in public funds spent on the project²⁷ were written off. The last commercial Concorde flight took off on 23 October 2003; Concorde has not been replaced.

1.6 Implicit in much industrial and science policy during the 1960s and 1970s was a belief in central planning, epitomised in the National Economic Development Council, or Neddys, and the Economic Development Committees ('Little Neddies')²⁸ at the sector level, views on both of whose merits have diverged increasingly over time:

"Had the Little Neddies not existed, it would almost certainly have proved necessary to create them."²⁹

1.7 Despite the lack of commercial successes and the difficulties inherent in both central planning and 'picking winners', much of government involvement in technology survived into the 1970s, if only by default, such that in 1973 confusion of government's continuing commitment to the Hovertrain project risked damaging the early career of a future President of the Board of Trade:

"Hovertrain – as the name suggests – was an improbable-sounding project to develop a

passenger train which could run at 300 miles an hour along a cushion of air created by magnetic levitation, powered by linear motors. The vehicle didn't need wheels, but did require a completely new type of track. Since 1967 governments had spent more than £5 million on the idea, channelled through a state firm called Tracked Hovercraft. Six years on, it needed another £4 million to survive, and Heseltine and his colleagues had to decide whether to put up the money."³⁰

The Plansters' Vision

1.8 From the perspective of the early twenty-first century, it is difficult to come to terms with the *hubris* implicit in the underlying belief of central planners not just in their own wisdom but also in their ability to implement policy by decree. Even when advocating regional development, the planning outlook was studiously centralised and top down, often to the point of absurdity, refusing to take account of rational individual living choices, the reasons why great business schools (MIT, Stanford, Chicago, Wharton) cluster around the commercial centres with which they have a symbiotic relationship, and even believing that a new Silicon Valley could be built five miles south of Glasgow:

"It is disturbing, but hardly surprising, to find a very high proportion of Britain's science-based industries in South-East England. This is not only because this is the part of Britain where most technological graduates prefer to live [...] It is a pity that neither of the first two graduate business schools is in a development region. This should be rectified in the second round of creation of business schools. The long-projected technological university on Tees-side should be given a high priority [...] To build up technological growth centres on the Boston, Palo Alto or East Kilbride model requires, therefore, full co-operation from the universities of the area concerned."³¹

1.9 The author of this vision, Michael Shanks, was a former treasurer of the Fabian Society who (along with Shirley Williams, Thomas Balogh, David Henderson, Anthony Crosland and Robert Neild) published a report broadly implemented by Harold Wilson in 1964 by splitting the Treasury to create the new Department of Economic Affairs, to which Shanks was seconded as an Industrial Adviser. The damage caused by top-down planning is difficult to assess, because not only

27 "Total expenditure on Concorde had reached £849 million by the end of 1980, and it was still rising." Spufford (2003) p47.

28 "Founded by the Macmillan Government in 1961, the Council was intended to provide a forum in which representatives of the Government, the TUC and the CBI could discuss and agree measures to improve economic performance. It was serviced by a secretariat, the National Economic Development Office (NEDO) which had originally been conceived as a very watered-down version of the French Commissariat du Plan. Particular issues were pursued in a series of so-called 'little Neddies' for specific industries." Lawson (1992) p714.

29 Shanks (1967) p130.

30 Crick (1997) pp172–3.

31 Shanks (1967) pp144–6.

must the costs of failed projects such as the Hovertrain be taken into account but the opportunities forgone would also need to be measured:

“Concorde was an anomaly now [December 1981] anyway. The sixteen planes³² had become technological orphans. They had only just managed to come into existence, by monopolising all the available investment and all the official attention, in the process killing off a whole range of other initiatives that might have been more fruitful and self-sustaining.”³³

- 1.10 Centralised policy readily became corporatist, further discouraging entrepreneurial small firms:

“When a British entrepreneur, Iann Barron, developed a mini-computer in the early 1960s and set up a new company, Computer Technology Ltd, to exploit it, he received little encouragement from government departments. ‘The Ministry of Technology did not like us because we were too small ... Government policy was being formulated by the big companies – they had the people to spare for lobbying and sitting on committees.’”³⁴

- 1.11 At the time, no equivalents of the US Small Business Investment Companies or the Small Business Innovation Research Program (see Chapter 2) existed in the UK. Instead, policy energies were more directed towards emulating the USSR, whose successful launch of the *Sputnik* satellite in 1957 had forced US technology policy to up its game. As Shanks noted with approval:

“An even more radical attempt at decentralization [than in France] is being made in the USSR. In 1957 more than 70 per cent of Soviet scientists and engineers engaged in R&D in academic institutes were working in the Moscow and Leningrad regions, and 40 per cent of all research institutions were in or near Moscow. A massive attempt is being made to create a rival pole of attraction for technologists near the remote Siberian railway town of Novosibirsk, home of the Russian academy of Sciences. Here the Russians have built an experimental satellite town, Akademgorodok, devoted exclusively to scientific and technological research and to providing the technological infrastructure for the industries of this formerly backward region.”³⁵

- 1.12 The resources poured into Akademgorodok would, ironically, ultimately benefit the US venture capital industry as emigration from the USSR to Israel

during the 1990s led to the growth of one of the most successful technology clusters outside Silicon Valley, a cluster supported, to a significant extent, by US investors³⁶. The benefits to the successors of the Soviet Union were less clear:

“Scientists here remember the lean years from 1991 to 1996 with horror, proffering graphs with drooping curves - testimony to the funding collapse - and charts with soaring curves to demonstrate the flow of scientists abroad.”³⁷

- 1.13 Akademgorodok now functions mainly as a provider of contract research. Looking back over the 1960s experiment with technology policy and central planning in the UK, it is hardly surprising that even without other pressing macro-economic concerns, technology fell out of favour as an area for investment or consumer preference:

“Benn flung himself into the Sixties technology with the enthusiasm (not to say language) of a newly-enrolled Boy Scout demonstrating knot-tying to his indulgent parents. Presently the entire land echoed to his pronouncements, and many shuddered at his vision of a hygienic, remote-controlled, automated future, the shudders becoming more pronounced as the technology with which the public came in contact showed more and more signs, as the decade moved towards its end, of total breakdown.”³⁸

Reversing Declinism

- 1.14 George Mikes tells of the desperate man who consults his rabbi because life is unbearable with nine members of the family all living in one room. The rabbi counsels him to take a goat into the room and come back in a week. After a week, the man reports that the goat has made life even less tolerable than before: ‘The rabbi told him: “Go home and let the goat out. And come back in a week’s time.”’ A radiantly happy man visits the rabbi a week later. “Life is beautiful, rabbi. Lovely. We all enjoy every minute of life. No goat – only the nine of us.”’ Mikes concludes—with some prescience, given that he was writing in 1977—‘All that has happened is that the goat has been taken out of the British economy.’³⁹

- 1.15 In fact, even in 1977 Arthur D Little⁴⁰, the consultants who identified the importance of small firms (though in Germany rather than the US) in the growth of technology sectors, reported that the most important step the government could take would be to cut taxes⁴¹

32 Two prototypes, two pre-production models and 16 production aircraft (two of which did not enter service) were built in total.

33 Spufford (2003) p47.

34 Owen (2004) p14. For a revealing parallel account of policy shifts towards SMEs in Japan at this time, see Whittaker (1997).

35 Shanks (1967) p148.

36 Gill et al. (2002) pp2–3.

37 ‘Town where a Soviet dream turned sour’ Amelia Gentleman in *Akademgorodok*, *The Guardian* 24 July 2000.

38 Levin (1970) p181.

39 Mikes (1977).

40 ADL (1977).

41 Owen (2004) p15.

but specific policy recommendations would have to await a wider economic restructuring following the appeal to the International Monetary Fund (IMF) in 1976. The aspirations of a ‘technological revolution’ were submerged in the reality of the macro-economy; the devaluation of sterling, deteriorating labour relations and relative productivity decline were shadows over both Labour and Conservative administrations for some 20 years after Wilson’s conference speech, to the extent that the perception of inexorable downfall was widespread. The resources to support science and technology were strictly limited and the impact of technology on the economy would in any event be minimal. As one later Secretary of State for Trade and Industry put it:

“I grew up with two unspoken yet unshakable assumptions about the future. The first was the irresistible rise of socialism [...] The other certainty was the inevitable decline of the United Kingdom [...] One of [Hermann Kahn’s] forecasts was that by the mid-nineties the prize for the lowest per capita income standard of living in the whole of Europe might well be shared by Albania and the United Kingdom [...] We now accept that there is no inevitability about our decline.”⁴²

1.16 Britain was forced into reform through acute economic circumstances, long-term under-performance coinciding with increasing capital mobility after the 1974 oil crisis. Investors doubted Britain’s ability to improve its underlying health, and Denis Healey as Chancellor of the Exchequer applied to the IMF for a conditional loan:

“In ten days the pound fell nearly ten cents below its level of March 3rd [1976]. Yet at that time our real economy was steadily improving. Our current account deficit was under £1 billion that year, compared with over £1.5 billion in 1975 and over £3.3 billion in 1974. Inflation was falling steadily. But the financial markets were now obsessed by their conviction that we were determined to contrive a big fall in the pound, so of course they did not want to hold sterling [...] The rest of the year was dominated by a series of negotiations around our application to the IMF. I had to negotiate on two fronts – to persuade the IMF to accept the smallest possible package of spending cuts, and to persuade the Cabinet to accept that package.”⁴³

42 Young (Lord Young of Graffham) (1990) pp1–2. Hermann Kahn was a futurologist at the Hudson Institute; his forecast was made in 1974. Lord Young almost emigrated to the US at this time, but drew back: see Young (1990), Chapter 1. For declinism, see further Gill et al. (2003) p13 n20.

43 Healey (1989) pp426–30. The IMF negotiations took place following Healey’s intervention at the party conference on 30 September 1976.

Technology Revolution Revisited

1.17 Fundamental change in the management of the economy continued through the 1980s. Productivity improvements were forced on industry through a combination of high exchange rates and high interest rates. Government would refuse to act as a long-stop for failing businesses or to behave as if it could plan the economy as a whole:

“The management revolution was due not only to the exchange rate squeeze and the move to higher nominal interest rates, but also to the end of the era of incomes policy and to the widespread impression that the Thatcher Government, unlike its predecessors, would not bail out loss-making firms at the first political outcry or indeed at all. The policy thus both established the Government’s counter-inflationary credentials and at the same time reinforced management’s newly rediscovered right to manage.”⁴⁴

1.18 Against this background of improved economic stability and revival in the industrial sector, a new set of policies to encourage innovation began to be implemented in the mid-1980s, with less fanfare but greater long-term success. Significantly, policy initiatives went hand-in-hand with market developments, reversing the top-down approach epitomised by the National Economic Development Council⁴⁵ of the previous two decades. For the purposes of commercialising technology, including university-originated research, the approximate coincidence of the emergence of a venture capital industry and the changes to the law on ownership of university intellectual property was one of the most important developments.

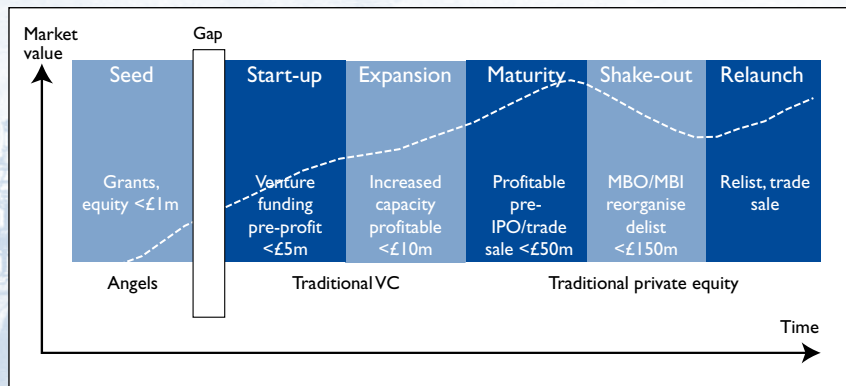
Venture Capital Beginnings – UK

1.19 It is evident that the background against which the venture industry developed in the UK was very different from the dynamic, market-oriented and research-intensive economy of the US during one of its greatest growth periods, from the 1940s to the 1970s (see Chapter 2). After the founding of Industrial and Commercial Finance Corporation (ICFC) in 1945, venture capital had started to emerge in the UK in the 1970s (where ‘captive’ UK bank funds

44 Lawson (1992) p57.

45 ‘[NEDC] was a symbol of a half-hearted corporatist past which had no place in a Britain which had decisively turned its back on the corporate state [...] this obsolete organization limped on, pointlessly, until Norman Lamont, Chancellor in the Major Government, announced its abolition in June 1992.’ Lawson (1992) pp714, 718.

Figure 1-1: Venture Capital vs. Private Equity – Traditional view: size/stage



were concerned, this may have been a consequence of competition and credit control regulations after 1971⁴⁶). However, it was not until 1983 that the British Venture Capital Association (BVCA) was formed as the emergent industry's representative body. In 1982, total amounts invested in the UK by UK venture capital organisations (including 3i) amounted to approximately £250m. By 1989, the figure was closer to £1,800m, although this did decline in the recession of the early 1990s to a low of just under £1,300m in 1991⁴⁷.

- 1.20 During the 1960s, an attempt was made to grow an indigenous technology-oriented investment firm, Technical Development Capital (TDC), formed in 1962 with £2m subscribed by insurance companies. ICFC took a 5% holding in TDC and also provided office accommodation. Its progress was slow, and in 1966 it was acquired by ICFC, enabling existing investors to cut their losses. Its aim, according to the ICFC Annual Report for 1967, was to ensure that “no worthwhile technical development fails to be exploited in this country merely through lack of financial backing at the commercial stage.”⁴⁸ One notable investment in 1967 was Oxford Instruments, founded in 1959 by (Sir) Martin Wood as a manufacturer of low-temperature superconducting magnets, based on work he had undertaken on superconductivity at the Clarendon Laboratory⁴⁹. TDC fact-finding missions studied MIT's methods, and collaborations were begun with both Cambridge University and Imperial College, but progress overall was limited:

“Investment levels began to fall significantly during the 1970s, reflecting both problems with the economy in general, and the end of the romance with technology in particular. The TDC experience [...] demonstrated the problems inherent in

46 Coopey and Clarke (1995) p160, who note that ‘The nature and origins of the venture capital industry are difficult to delineate with any precision. As early as 1971 the Bolton Committee Report, for example, referred to the “emergence of a number of venture capital companies specializing in small firms.”’

47 Ibid. Figure 7.4, p163.

48 Ibid. p86.

49 Owen (2004) p14.

investing in what was, by its nature, a very volatile sector of industrial activity.”⁵⁰

- 1.21 In contrast to the market-friendly reforms in the US during this period, Britain was subject to high taxation (as Chancellor of the Exchequer in 1975, Denis Healey had promised to ‘squeeze the rich till the pips squeak’), a disincentive to enterprise and a barrier to the accumulation of capital necessary for the development of an active business angel market. Furthermore, it is notable that the other ICFC initiative undertaken at about the same time as TDC was Industrial Mergers Ltd, formed in 1967 to assist ICFC customers caught up in the merger wave encouraged by government policy picking out elements of the US success story rather than seeing it in the round:

“This trend was encouraged by the Labour government's intervention in 1966 in the form of the Industrial Reorganisation Corporation (IRC). Large organisations, typified by the American multinational corporation, were held to be the most efficient economic units. Studies have since noted that many of the mergers which took place around this time did little to increase efficiency, plant size often being unaffected within new groupings.”⁵¹

- 1.22 The effects of government policy may have been even more destructive than simply failing to achieve efficiencies:

“Quite apart from the direct effect of government industrial policy, merger activity was running strongly during the 1960s. A buoyant stock market facilitated share-based acquisitions, and the government made little use of its power to prohibit anti-competitive mergers. Tax policy, too, tended to favour the larger firms. With capital gains tax at 30 per cent, compared to marginal income tax rates which could be as high as 90 per cent, entrepreneurs starting new businesses had little incentive to expand them. As one businessman wrote later, ‘most successful entrepreneurs tended to sell out to sleepy, poorly managed listed companies; these companies grew larger still, and increasingly complacent, via relatively cheap and easy acquisitions.’”⁵²

- 1.23 The current landscape of risk capital provision in the UK is described in detail in Chapter 2. One clear feature of most funding generically described as private equity in the UK is that it is now funnelled into later-stage transactions such as MBOs and delistings. This will necessarily impact the ability of many firms at early stages to step onto the ‘funding escalator’ and has been frequently analysed as a possible systemic or market failure (see Figure 1-1).

50 Coopey and Clarke (1995) pp86–87.

51 Ibid. p87.

52 Owen (2004) p15, citing John Hoskyns, *Just in Time; inside the Thatcher revolution* Aurum Press, 2000, p7.

Funding Gap, Readiness Gap... or Venturesome Consumer Gap?

As *Funding Technology – Britain Forty Years On* went to press, two reports were published which threw more light on the long-running debate on whether there is an equity gap in Britain and if so where it is in terms of size.

In *Beyond the Chasm – the Venture-Backed Report UK 2006* Library House used its own database to analyse the population of UK deals by size range and investor type. It noted that the UK government tends to place the level at which informal supply falls off at around £250k and that investor surveys estimate the level below which institutions are unwilling to invest as being between £1.5-2m. Library House concluded that:

'The distribution of deal sizes [for deals by public sector organisations and public sector backed funds] is clearly centred around the equity gap.'^I

Public sector deals were most numerous between £100,000 and £500,000, with a sweet spot at £250,000. Furthermore, funding in the assumed gap was not confined to the public sector:

'Of the 1,511 institutional (excluding public sector backed funds) deals with disclosed value, more than half (899) are £2m or below. Moreover, the vast majority (706) of the sub-£2m deals are between £250k and £2m, squarely in the area traditionally seen as the equity gap.'^{II}

Taking all these factors into account, Library House concluded that the real gap in the UK is more one of readiness than of funding:

'A comparison of the funding requirements of companies with subsequent funding received shows that a significant gap remains between desire for funding and actual investment. However, this phenomenon is only partially related to the level of funding available and is more reflective of the fact that the majority of companies seeking funding simply do not have the potential required to warrant investment by an investor motivated by financial gain.'^{III}

Both angel and venture fund investors are likely to agree instinctively with this conclusion. But can any more light be thrown on what is meant by the gap being 'partially related to the level of funding

available', to use Library House's phrase?

Published at the same time as *Beyond the Chasm*, "Secrets" of the World's Largest Seed Capital Fund by David Connell of the Centre for Business Research at Cambridge also tackled the equity gap, but from a different angle:

'The "equity gap" has been debated for as long as the UK's poor performance at exploiting its science base [...] In reality, over a prolonged period of 20 years, it [the venture capital industry] has demonstrated an inability to deliver average returns for its own investors [...] As a director of one of the most experienced firms in the alternative assets community put it, "you would not propose investing in European (including UK) venture capital unless you thought something was going to change."^{IV}

Connell broadens the perspective such that funding issues are not seen wholly or mainly as an equity or venture capital problem:

'The lack of other sources of funding for early stage companies is recognised as one of the underlying reasons for poor UK and European early stage technology VC performance [...] If we continue in the UK to expect VC firms to bear the brunt of financing early stage science and technology companies which are not "venture ready", we will only help them deliver returns which turn off their own investors and reduce the level of genuine private sector venture capital which is available in the UK.'^V

The solution proposed is for a UK version of the US Small Business Innovation Research (SBIR) Programme, which was established in 1982 and each year makes over 4,000 awards to small businesses for an aggregate of \$2bn or more. SBIR awards are made in the form of government contracts for the development of technology for government agencies such as the Department of Defense and the National Institutes of Health.

In other words, the 'equity gap' cannot usefully be understood by considering venture investment in isolation. Broadening the perspective still further, Dr Alex Smeets of the St John's Innovation Centre in Cambridge has analysed the extent to which increasing both venture capital and R&D spend as a proportion of GDP has a positive impact on labour productivity, employment rates and GDP. Taking R&D first, Figure 1-2 challenges a simplistic view of the value of increasing investment in research without also changing other factors. For the UK:

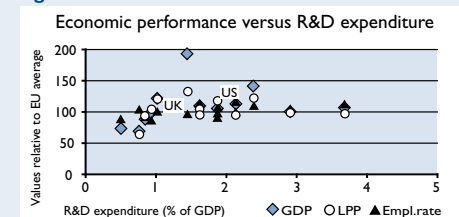
'The economic indicators show a positive correlation with R&D spend, but only up to just below 1.5%

R&D spend as a proportion of GDP. Above that level there is no further improvement in economic performance as R&D spending goes up, at least for European countries [...] Luxembourg aside, clearly on the basis of this data it is pointless to increase R&D spend beyond 1.5% of GDP.'^{VI}

This immediately suggest that the EU's Lisbon target of 3% and the UK's target of 2.5%, without other structural adjustments as in the US, are misguided. The OECD's 2003 study threw some light on which types of R&D were most likely to prove effective, while also providing some caveats:

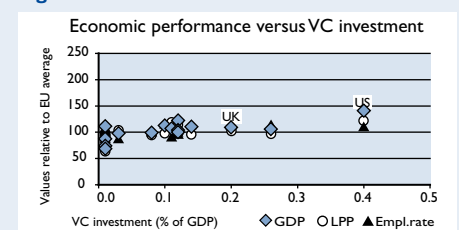
'The results also point to a marked positive effect of business-sector R&D, while the analysis could find no clear-cut relationship between public R&D activities and growth, at least in the short term. The significance of this latter result should not however be overplayed as there are important interactions between public and private R&D activities as well as difficult-to-measure benefits from public R&D (e.g. defence, energy, health and university research) from the generation of basic knowledge that provides technology spillovers in the long run.'^{VII}

Figure 1-2



Dr Smeets applied the same analytical approach to venture capital as he did to R&D, with similar results (see Figure 1-3 below):

Figure 1-3



'[W]ith some imagination you can say that economic performance goes up with VC spend, but only up to around 0.05% of GDP. Above that level (which is only half the European average), increased VC spend does not result in further improvements in economic performance, at least for European countries. So, once again we are in danger of staring ourselves blind trying to increase the level of finance available, when

I Library House (2006) p44.

II Ibid.

III Ibid.

IV Connell (2006) p38.

V Ibid. p39.

VI Private communication to the authors, July 2006.

VII OECD (2003), p17. We are grateful to Dr Terence Kealey of Buckingham University for drawing our attention to this report.

evidently this by itself is not going to lead to improved economic performance.’^{viii}

If this analysis holds true, in addition to the ‘usual suspects’ of factors to be improved to increase competitiveness and hence GDP (education, research and development, infrastructure, taxation, regulation, supply of [serial] entrepreneurs, suitable premises, mobile labour force), one perhaps surprising candidate for improvement emerges in the form of innovative – or venturesome – consumers.

In *Venturesome Consumption, Innovation and Globalization*, a paper^{ix} for a joint conference of CESifo and the Center on Capitalism and Society held in Venice in July 2006, Professor Amar Bhidé of Columbia University adopted a robustly contrarian approach to an emerging consensus of techno-fetishism and techno-nationalism in Western attitudes to globalization:

‘The mindset incorporates two related tendencies. One is the focus on the upstream development of new products and technologies while glossing over their downstream consumption and use. The other is the belief that national prosperity requires upstream international leadership in upstream activities – “our” scientists, engineers, entrepreneurs, and firms have to be better than everyone else’s – they must write more papers, file more patents and successfully launch more products. Otherwise, competition from low-wage countries like China and India will erode living standards in the West especially as they upgrade their economies to engage in more innovative activities.’^x

Such thinking, he notes, has undoubtedly informed British public policy:

‘Gordon Brown’s 2006 Budget Statement noted that China and India had “4 million graduates a year to Britain’s 400,000” as well as more computer scientists and engineers. “Every advanced industrial country knows that falling behind in science” he said “means falling behind in commerce and prosperity.”’^{xi}

viii Private communication with the authors.

ix Bhidé (2006). We are grateful to Mr Christopher Saunders for drawing this paper to our attention.

x Bhidé, A. (2006) p1, citing Ostry and Nelson (1995).

xi Ibid. pp5-6. For further background on the thinking behind post-neoclassical endogenous growth theory, closely identified with Mr Brown since he was Shadow

Professor Bhidé argues instead that the role of venturesome consumers is critical in developing and sustaining an innovative economy:

‘the willingness and ability of individuals to acquire and use new products and technologies is as important as – and in small countries more important than – the development of such products and technologies. Moreover nations – unlike many individuals and organizations – don’t have to outperform ‘competitors’ in order to prosper. *Notwithstanding the rhetoric about the competitive advantages of nations – a transplant from the domain of inter-firm rivalry that has displaced references to old-fashioned comparative advantages – countries are not locked into zero-sum trade. An innovation originating in one country does not impoverish other countries.* Rather it tends to improve standards of living in all countries that have the downstream capacity to acquire and implement the innovation.’^{xii}

He even turns on their head many contemporary concerns about the negligible savings ratios of households in some dynamic economies, especially the US:

‘The propensity of consumers to open their hearts and wallets to new offerings also involves the dilution of prior beliefs in the moral and economic value of thrift. Through the end of the 19th century, according to Max Weber’s thesis, religious convictions about thrift sustained the ‘spirit of capitalism’. Weber argued that merchants and industrialists accumulated capital in the belief that they had a moral duty to strive for wealth as well as to lead austere lives. In fact, because venturesome production requires venturesome consumption, excessive thrift can injure rather than help modern capitalism. As it happens, modern consumers have been more inclined to keep up with the recently acquired baubles of their neighbors (if not stay ahead) than towards excessive thrift.’^{xiii}

So plugging the funding gap may require filling the gap in venturesome consumers – or ‘crossing the chasm’ between early product adopters (technology enthusiasts and visionaries) and the early majority (or pragmatists), as Geoffrey Moore put it in his 1991 classic study of technology marketing^{xiv} alluded to in the Library House report.

Chancellor, see Romer (1990).

xii Bhidé (2006). Emphasis added.

xiii Ibid. p31.

xiv Moore (1991).

One of our interviewees, when asked what he thought of technology venture capital in the UK today, replied as Gandhi did when asked for his opinion of Western civilisation: he thought it would be a very good idea. However, before addressing the supply issue, we need to consider the ‘absorptive capacity’ of early-stage technology firms in the UK, and in particular whether the quality of management warrants substantially more risk capital.

Entrepreneurial Revival?

- 1.24 Venture funds often maintain that their inability to invest at early stages is not due to unwillingness on their part to look at good ideas at the conceptual phase; rather, one of the most important gaps in the British innovation chain is the absence of seasoned entrepreneurial managers able to convert ideas into reality. However, attitudes have changed. As Peter Hiscocks, former director of the University of Cambridge Entrepreneurship Centre has noted, a generation ago if a graduate of a respectable university announced an intention to set up in business, the reaction was likely to be, “But *just how badly* did you do in your Finals?”
- 1.25 Forty years on, entrepreneurship may still not automatically attract the immediate attention of the brightest and best as on the West Coast of the US but it has ceased to be associated primarily with sheepskin jackets and *louche* motor cars as it was even in the 1980s, when Arthur Daley, the Trotter brothers and Robert Maxwell were confabulated in the popular imagination. Despite national and international surveys focused on external factors such as the business start-up, closure and ‘churn’ rates, or on survey responses to regional propensity to set up in business, entrepreneurship is peculiarly resistant to survey and other ‘macro’ evidence. Like the creative arts, it depends substantially on the character of individualists creating new paths and spotting linkages and opportunities never before seen, however obvious those linkages may seem *ex post*. (Surely, we say with hindsight, the military and academia could see even in the 1970s how popular electronic mail would be.)
- 1.26 That said, *situation* can be as important as personality: public policy and the overall business environment matter. ‘Structural’ changes in the UK favouring entrepreneurship in recent years have included:
- amending the law on bankruptcy to lessen the penalties for ‘honest’ failure (Enterprise Act, 2004);
 - significant public investment in teaching entrepreneurship skills at undergraduate and postgraduate level; and
 - relatively low levels of taxation (especially on capital gains) when compared with direct competitors including the US, even if the UK tax remains unduly complex in its details: “by comparison with Gordon Brown’s maze of tax credits and investment

reliefs, the US tax system is simpler and more encouraging, both for venture capitalists and for scientists hoping to turn ideas into business.⁵³

1.27 Many policy changes are relatively recent in the context of a forty-year overview of UK innovation and accordingly have not yet had time to prove themselves. Entrepreneurship education at the university level was the subject of considerable scepticism initially on the grounds that ‘entrepreneurship’ is more a character trait than a skill-set. However, early experience suggests that entrepreneurship education has been valuable in providing specific business skills to relatively inexperienced individuals⁵⁴ and that the formal education setting also provides a venue for ambitious students to meet successful role models on a regular basis. Evening presentations or ‘brown bag lunches’ by established business leaders willing to give their time and enthusiasm often also attract specialist professional advisers (accountants, solicitors, even investors), who in turn offer useful introductions to engineering and other students considering branching out on their own.

1.28 Entrepreneurship education at its best, therefore, combines technical skills (finance, marketing, team management, business planning) with the ability to meet experienced intermediaries and be inspired by successful entrepreneurs. To the extent that entrepreneurship does depend on character traits, these cannot be implanted but may be stimulated and channelled through a formal learning approach. It is gratifying and perhaps surprising that enthusiasm for entrepreneurship among students has remained high after the dot.com debacle⁵⁵.

Entrepreneurship Now

1.29 As Barreto noted⁵⁶, modern neoclassical economic theory does not require entrepreneurs because it emphasises static resource allocation problems: perfect information, rational choice, output completely defined from a set of inputs, no inconsistent elements. None of the historical roles of the entrepreneur (coordination, risk, innovation, arbitrage) would be required in such an economy. But such a ‘classical’ approach appears to ‘assume a tin opener’⁵⁷, and provides no insight into the developing role of entrepreneurs particularly in technology sectors in Britain today. This brings us back from situation to individual.

1.30 As discussed later in relation to bank funding for technology firms at early stages, such businesses represent numerous layers both of risk and of uncertainty; for instance, product risk (does the technology work?), market risk (who will buy it?) and, above all, management risk (has this management team succeeded in anything like this before, and did they just get lucky?). Accordingly, entrepreneurship (Say’s fourth factor of production) is required because of the numerous inconsistencies and resource allocation issues inherent in new technology markets. Above all, resource allocation issues are *not* static but dynamic: the impact of the entrepreneur changes the market place itself, and the entrepreneur is not merely a conventional factor of production, a statistically predictable subset of labour, but the driving force behind efficiency gains, which are usually treated as a residual once the impact of capital and labour as economic inputs has been assessed.

1.31 To give a simplified example, a technologist might devise the system on which e-mail operates; a researcher might use it for academic purposes; but only an entrepreneur will spot the wider opportunities inherent in the worldwide web, persuade investors to provide capital and market it to early-adopters before much complementary content is on offer or the network benefits of numerous other users arise. Risk and uncertainty bearing, coordination and arbitrage are as necessary as innovation itself where new technologies for new markets are concerned.

1.32 The importance of entrepreneurs as individuals provides a further example of the uneasy progress made in funding technology in Britain over the past forty years. Entrepreneurship courses provide valuable technical input to a new generation of students, but would be a machine without a ghost to animate them in the absence of successful entrepreneurs to inspire the next generation through personal example at lectures, meetings and network events. Are there enough experienced entrepreneurs to go round? Only just, perhaps; but many are committed to putting back more than they have taken out through helping the next generation. Consider the following, all taken from *Cambridge Entrepreneurs in the Business of Technology*⁵⁸:

“Having gone through the process of founding a business and seeing how decisions get made in the business world, I think I have more to contribute now than I might have done if I had gone into Parliament [...] I get a lot of satisfaction from being in a position to advise and from feeling that I have been able to make a useful contribution.”⁵⁹
– Dr David Cleavelly, *Founder of Analysis*

53 Vander Weyer (2006).

54 See, for example, Lucas and Cooper (2005).

55 Price et al. (2004).

56 Barreto (1989)). See also Casson (2003).

57 Readers will recall the conversation between numerous experts asked to explain what they would do if marooned on a desert island with crates of tinned food but no tin opener. Each suggested a solution appropriate to his craft; the economist said that he would ‘assume a tin opener’.

58 Beveridge (2001).

59 Ibid. p97.

What is Entrepreneurship?

So far we have avoided saying what entrepreneurship is. The answer would vary across the past two centuries or so. One recent survey teases out a taxonomy first proposed by Humberto Barreto: 'Barreto classifies the roles played by the entrepreneur in the history of economic thought into the four categories of coordination, arbitrage, innovation and uncertainty bearing.'^I

On this analysis, the **coordination role** of the entrepreneur was identified by Jean-Baptiste Say (1767–1832), whose *Treatise on Political Economy* (1803)^{II} Napoleon sought to have amended to conform to the protectionism of the war economy. Say identified the entrepreneur as 'the link of communication' between the 'various classes of producers' and between the producer and the consumer^{III}.

Say and Richard Cantillon^{IV} (c.1680–1734) saw the **risk-bearing role** of the entrepreneur as vital, and Say considered it the fourth factor of production along with land, labour and capital. Producers such as farmers pay fixed costs for inputs such as seed or labour but would not have a committed price for their harvest; neither, in due course, would the middlemen, the wholesalers or the retailers: 'Cantillon suggested that entrepreneurs performed the vital economic function of committing to buy inputs without knowing how much customers would pay for their end products.'^V

As for the distinction between risk and **uncertainty-bearing**, the American economist Frank Knight (1885–1972), one of the founders of the 'Chicago School', distinguished between risk (which is insurable) and uncertainty (which is not). Risks are recurring events and can be laid off through insurance; uncertainties the entrepreneur must bear himself. The magnitude of the uncertainties will explain the long-run profitability of an industry where entrepreneurs are free to enter and leave or at least with low costs.^{VI}

The 'Austrian School' does not see the entrepreneur as a risk-bearer. Joseph Schumpeter 1883–1950 famously saw the entrepreneur as an **innovator**, leading the way in the creation of new industries through a process of 'creative destruction' and motivated by the 'dream and the will to found a private kingdom'. He argued that: 'Risk obviously always falls on the owner of the means of production or of the money-capital which was paid for them, hence never on the entrepreneur as such.'^{VII}

Beneath this high-level vision, other members of the Austrian School, such as Israel Kirzner (b. 1930) and Friedrich Hayek (1899–1992)^{VIII} identified the **arbitrage-role** of the entrepreneur. In a socialist or centralised economy, bureaucrats or policy-makers have no incentive to find out prices driven by supply and demand, but in a market economy entrepreneurs are driven by the profit motive to sell products at higher prices than they paid for them. The entrepreneur moves markets towards equilibrium through profit arbitrage.^{IX}

I Bhidé (2000) p6.

II *Traité d'économie politique, ou simple exposition de la manière dont se forment, se distribuent, et se composent les richesses*. Several editions were produced during Say's lifetime.

III Bhidé (2000) p6.

IV *Essai sur la nature du commerce en general*. The excellent brief account in Bhidé may err in describing Cantillon as 'an eighteenth century French economist'. He was of Irish descent and broad European connections, and made his fortune in France through John Law's Mississippi schemes before moving to London, where he died in a fire at his house in Albemarle Street caused by his cook as an act of revenge. W S Jevons (1835–82), an early pioneer of marginal utility theory, saw in his work 'an almost complete anticipation of the Malthusian theory of population'. See Murphy (1997).

V Bhidé (2000) p6.

VI Knight (1921).

VII Schumpeter (1939), p75, cited in Bhidé (2000), p6.

VIII In 1931, Hayek wrote an introduction and commentary on a German translation of Cantillon.

IX Kirzner (1973).

"I thought it important to do something worthwhile for humanity."⁶⁰ – *Ali Pourtaheri, CEO of Ubinetics*

"I have learned that people who work with their minds are motivated by spiritual rather than financial rewards."⁶¹ – *Henry Azima, Head of Technology at NXT*

1.33 The current wave of entrepreneurial enthusiasm in the UK is relatively recent, dating perhaps from the mid-1990s only and so not long enough to have produced the breadth and depth of serial entrepreneurs prevalent in Silicon Valley. But many successful ones are happy to spread themselves thinly in an attempt both to repeat their own successes and to inspire others to do so. Successful serial entrepreneurs often also contribute to the next generation of success stories as business angels, another critical ingredient of the golden chain of innovation notoriously resistant to conventional analysis and measurement. Entrepreneurs appear to sit outside conventional economic theory and this may be reflected in their ability to spot and follow through on unconventional opportunities. Fortunately for technology innovation in the UK, many of them are only too happy to 'bite more of our generals' (as George II said of Wolfe) in the form of students and managers of conventional businesses seeking to tunnel out.

Education – Universities

1.34 "First we shape our buildings, and then they shape us."⁶² A common criticism of British society in the 1960s was that its educational system did not support technological innovation or indeed the needs of society more generally. Sampson notes that "[i]n 1961 the government responded to more than half a century's protest in the usual way: they set up a Committee of Enquiry under Lord Robbins." The Robbins report was accepted for publication on 24 October 1963:

"Even if you add in teacher training colleges and technical colleges as equivalent to universities, only 8.5 per cent of the age-group entered full-time higher education in Britain in 1962 [...] In science and technology, for instance, 4 per cent of the Russian age-group finished degree courses in 1961–2, compared with 2.4 per cent in Britain."⁶³

1.35 Criticism of British university education went back well beyond the half century identified by Sampson. Symonds notes criticism of the Oxford system from

60 *Ibid.* p76.

61 *Ibid.* p44.

62 Churchill on the rebuilding of the House of Commons, 1945. See www.winstonchurchill.org.

63 Sampson (1965) pp218–9.

insiders from the last years of the nineteenth century. Sir E R Lankester, holder of the Linacre Chair in Comparative Anatomy, in his Romanes Lectures in 1905 attacked the hegemony of Classics over physics, chemistry, geology and botany. His predecessor shared his sentiments:

“Moseley was reminded of Oxford when he visited the Examination Halls of Peking on his voyage as naturalist to the *Challenger*; in both cases, he noted, the main energies had been devoted to the study and reiterated translations of the mouldy and worm-eaten lore of a bygone age.”⁶⁴

1.36 The 1960s policy response was the creation of 14 new ‘plate glass’ or ‘Robbins’ universities (Brunel, Bath, Bradford, East Anglia, Essex, Kent, Keele, Lancaster, Stirling, Surrey, Sussex, Warwick, Ulster and York). Some had already been planned before Robbins reported (Sussex 1961, York 1963). Over the next 40 years, these became successful and popular universities: York regularly features among the top half dozen in the UK for teaching and research, Warwick pioneered co-operation with industry in the Midlands, Brunel led a consortium of higher education institutions in regional economic regeneration, and Sussex produced two Nobel prize winners in chemistry (Sir John Cornforth, 1975; Sir Harry Kroto, 1996; the Department is currently threatened with closure) and one in physics (Sir Anthony Leggett, 2003; he currently works at the University of Illinois, Urbana-Champaign).

1.37 If the new universities helped to improve general levels of higher education in Britain from the 1960s, it is less clear that they enabled a relative international weakness in science and technology to be reversed. As Britain improved, much of the rest of the world improved at least as fast. The origins of national weakness were deep-rooted, and in several ways another baleful legacy of Empire. Reviewing Oxford’s curriculum during the period of the University’s apogee (1870–1939), Symonds noted:

“Most of the Oxford scientists in the late nineteenth and early twentieth centuries were fervent Darwinites [...] In their time only a small minority of students studied Natural Sciences; in 1887 of those entering for honours examinations only 5.3 per cent were studying the subject. The proportion rose to 13.5 per cent by 1912, but this was still far lower than at Cambridge where the figures were 20.9 per cent in 1887 and 24.3 per cent in 1912. In general, the professors of science believed that Oxford’s excessively classical orientation, its system of examinations and its lack of support for research caused the leadership of the nation and Empire, which it so largely supplied, to be dangerously illiterate in science [...]”⁶⁵

1.38 The changes at Cambridge were relatively recent, in part a response to the criticisms of the University by Prince Albert, elected Chancellor of the University in 1847 after a keen contest with Earl Powis, when he compared the Cambridge curriculum unfavourably with that of universities in his native Germany. But much tangible progress had to wait until after Prince Albert’s death (1861), despite the inauguration of a Natural Sciences Tripos in 1848:

“After more than twenty years of fly sheets, votes in the Senate House and arid discussion it was at last decided in 1868 to set up a committee on the teaching of experimental physics. It recommended establishing a chair and a laboratory. But how to pay for the laboratory? The next year William Cavendish, by then Duke of Devonshire and Chancellor of the university, offered to pay the whole sum.”⁶⁶

1.39 The Cavendish Laboratory attracted outstanding leaders from the outset: James Clerk Maxwell, Lord Rayleigh, J J Thomson. As Annan noted,

“Nobel Prizes descended regularly on the Cavendish scientists: Rutherford, Francis Aston, Charles Wilson, Lawrence Bragg, Owen Richardson, Edward Appleton and JJ’s son George were all laureates [...] The triumphs owed as much to ingenuity in building apparatus as to scientific induction or intuition. JJ fought hard to get funds from the university, but most of the apparatus was hand-made – in the proverbial manner of sealing wax and string.”⁶⁷

1.40 Despite this apparent parsimony, such was the success of the natural scientists in obtaining land and resources that the appearance of Cambridge was changing rapidly: “for even by 1 March 1904 there were buildings on the Downing site fit to be opened by the King himself. Indeed the progress of science in Cambridge during only fifty years had changed dramatically the visible form of the University and Town.”⁶⁸ The success of the scientists led Francis Cornford in his memorable dissection of academic politics, *Microcosmographia Academica* (1908), to identify them as a distinct party within the University, along with Conservative Liberals, Liberal Conservatives, Non-placets and Young Men in a Hurry:

“The *Adullamites* are dangerous, because they know what they want; and that is, all the money there is going. They inhabit a series of caves near Downing Street. They say to one another, “if you will scratch my back, I will scratch yours; and if you won’t, I will scratch your face.” It will be seen that these cave-dwellers are not refined, like

an Oxford classicist.

66 Annan (1999) pp119–20.

67 Ibid. pp122–3.

68 Johnson (1994) p43.

64 Symonds (1986) pp124–5. H V Moseley, 1844–91.

65 Ibid. p124. Note, however, that Sir Anthony Leggett was originally

classical men. That is why they are successful in getting all the money there is going.”⁶⁹

British Universities Today

1.41 “Further education in the UK is now larger than agriculture,”⁷⁰ but the standing of UK universities today is ambiguous and precarious. On the one hand, a handful ‘punch above their weight’, to use a much-repeated term, and have created a collegiate system more respected among policy-makers abroad than at home; on the other, even the best UK universities are overly dependent on government funding, and so lack autonomy and are subject to policy agendas (equality, diversity, regional development) not directly relevant to teaching and research. Such confused priorities take up resources better employed elsewhere:

“Indeed, the to-ings and fro-ings about the Access Regulator remind one of Milton Friedman’s warnings that when one starts tampering with the market, one has to go on tampering at an exponential rate. In turn, Secretary Clarke’s effort to give freedom to the universities was reminiscent of the urban myth about the Chinese politburo: having decided to introduce a market system (‘Marxism with Chinese characteristics’) they at once sent a mission to the West to find out who allocated materials.”⁷¹

1.42 In the 2006 Academic Ranking of World Universities prepared by the Institute of Higher Education at Shanghai Jiao Tong University, two UK universities were ranked in the top ten: Cambridge in second place in the world, behind Harvard and ahead of Stanford; and Oxford in tenth place. Imperial College (23rd) and University College London (26th) ranked ahead of the Swiss Federal Institute of Technology in Zurich (27th) and University of Utrecht (40th); no other European university appeared in the top 40, though Tokyo, Kyoto and Toronto are in the top 25. The Shanghai ranking, like all such exercises, has attracted criticism (in this case mainly for emphasising sciences rather than arts, as Nobel Prizes and Fields Medals are included, but not Pulitzer Prizes or Grammy awards), but its methodology is reasonably objective and particularly appropriate for a survey of technology excellence:

“We rank universities by several indicators of academic or research performance, including

alumni and staff winning Nobel Prizes and Fields Medals, highly cited researchers, articles published in Nature and Science, articles indexed in major citation indices, and the per capita academic performance of an institution.”⁷²

1.43 Examining the Shanghai list largely confirms Roy Jenkins’s analysis nearly 20 years ago, though he could not then have predicted the likely rise in university rankings in Asia:

“Just as an Oxonian should not deny that the flame of intellectual enquiry burned most brightly beside the Cam in the inter-war years, so I do not think that either of us, Oxonians or Cantabrigians, should deny that in the forties and fifties it had substantially migrated, for reasons outside our control, to the banks of the Charles River and the purlieus of Harvard Yard. Quite where it is today is more difficult to decide. Still in the United States, I think, but more disseminated in accordance with the westward tilt in the balance of the country, and with Berkeley and Stanford able to claim at least a piece of the true cross.”⁷³

1.44 While considerable effort is expended on the Research Assessment Exercise (the next will take place in 2008)—which as the name suggests targets mainly research—it is the teaching element of UK university life which has started to excite the greatest interest in America, to the extent that a best practice group, the Collegiate Way, has been formed:

“If universities are to have the transformative effect they ought to have on the lives of young people then the faculty must become the principal influences on student life throughout their institutions. They can do this by reviving one of the oldest models of university structure in existence: the decentralized residential colleges of Oxford and Cambridge Universities in Great Britain. Within these small collegiate communities—communities that include young and old, rich and poor, student and professor, artist and scientist—a stable, challenging, and diverse social and intellectual environment can be restored.”⁷⁴

1.45 Numerous universities in the US and elsewhere have set up a college system in recent years (including Rice, Michigan State, Murray State, Northwestern, Truman

⁶⁹ Johnson explains that the ‘men that were in cumbrance and in debt and troubled in their heart’ who gathered unto David at Adullam were poised to capture the Kingdom (1 Samuel 22:1). ‘In 1866 “Adullamite” was used famously by John Bright as a nickname for a group of Liberal Members of Parliament [...] who seceded from the Liberal Party out of dissatisfaction with Lord John Russell’s attempt to carry a measure of Parliamentary reform.’ Johnson (1994) p47.

⁷⁰ Allott (2006) p17.

⁷¹ Stevens (2004) p167. The Office for Fair Access is unaffectionately known as ‘OffToff’.

⁷² <http://ed.sjtu.edu.cn/rank/2006/ARWU2006Methodology.htm>

⁷³ Roy Jenkins, Rede Lecture 1988. Reprinted with amendments in Jenkins (1993) p143. However, noting that American universities are in poll position not because they are so good but because the rest of the world is so bad, in the wake of Larry Summer’s resignation as President of Harvard, The Economist suggested that ‘no American dean should bet on this lasting for ever. Oxford and Cambridge are getting their acts together, Switzerland is attracting some academic stars and China is ploughing money into higher education.’

Remember Detroit: America’s universities need to fix themselves while they are still on top. 11th March 2006 p12.

⁷⁴ <http://collegiateway.org/>, accessed on 5 March 2006.

Table I.1: World University Rankings 2006

World Rank	Institution	Country	Total Score
1	Harvard University	USA	100
2	University of Cambridge	UK	72.6
3	Stanford University	USA	72.5
4	University of California - Berkeley	USA	72.1
5	Massachusetts Institute of Technology (MIT)	USA	69.7
6	California Institute of Technology	USA	66
7	Columbia University	USA	61.8
=8	Princeton University	USA	58.6
=8	University of Chicago	USA	58.6
10	University of Oxford	UK	57.6
11	Yale University	USA	55.9
12	Cornell University	USA	54.1
13	University of California - San Diego	USA	50.5
14	University of California - Los Angeles	USA	50.4
15	University of Pennsylvania	USA	50.1
16	University of Wisconsin - Madison	USA	48.8
17	University of Washington - Seattle	USA	48.5
18	University of California - San Francisco	USA	47.7
19	Tokyo University	Japan	46.7
20	Johns Hopkins University	USA	46.6

Source: Institute of Higher Education, Shanghai Jiao Tong University, <http://ed.sjtu.edu.cn/ranking.htm>

State, UC San Diego, North Carolina—by no means all private universities). Princeton introduced the collegiate system in the 1980s for academic as much as practical purposes:

“Each college has a senior faculty member who serves as college master, a director of studies who is responsible for academic advising and disciplinary matters, and several dozen other faculty members, administrators and members of the Princeton academic community as fellows. This staffing ‘sends a clear signal that they are to be centers not only for living but for learning,’ a university report declared in 1994.”⁷⁵

1.46 But the collegiate system is one apparently without honour in its own land. Noting that the “British suffer because they have little idea what universities are for. They are confused about the difference between excellence and elitism, and between equality of opportunity and equality of outcome”, Robert Stevens, a former Professor of Law at Yale, Chancellor of the University of California-Santa Cruz and Master of Pembroke College, Oxford, argued that,

“This government has achieved the goal of weakening the colleges by various devices. By far and away the biggest change was Baroness Blackstone’s abolition of the college fee. Basically, Oxford was singularly (and probably unfairly) advantaged by having an additional fee, in addition to the block grant to the university. The money - a reduced sum - is now paid

through the university, which is under a moral, but not a legal, obligation to pass it on to the colleges. Over a ten-year period, Oxford will lose nearly a third of its teaching income.”⁷⁶

1.47 The US university system has shortcomings, including costs for students and the pressure to publish for faculty, but as the Shanghai league table shows, it has achieved hegemony in international rankings. Most leading US universities have broader sources of income than are available to those in the UK, dominated by a government funding system which barely covers, if that, the cost of tuition for EU undergraduates (higher fees may be charged to students from further afield). Rather than seeking an unobtainable ‘parity of esteem’ like their British counterparts, US universities also clearly fall into numerous different types. For instance, as President of the University of California in the late 1950s, Clark Kerr introduced the California Master Plan for Higher Education to accommodate significant increases in student numbers and to balance excellence with the widest access. Excellence in education has been a cornerstone of California’s leadership in the knowledge economy. Under the California system:

- a few University of California campuses (Berkeley, Davis, Irvine, Los Angeles, Merced, Riverside, San Diego, San Francisco, Santa Barbara, Santa Cruz) act as top level research institutions;

⁷⁶ The Spectator, 14 July 2001. Professor Stevens is also Of Counsel to the Washington Law firm of Covington & Burling, of which Dean Acheson, who noted Britain’s inability to find a role after losing an empire, was a partner.

⁷⁵ Oberdorfer (1995).

- more numerous California State University campuses handle the majority of undergraduate students; and
- numerous California Community College campuses provide mass vocational programmes⁷⁷.
Transfer between sections is possible on merit.

Management Education

1.48 A more convincing candidate for blame than either schools or universities for educational shortcomings *directly* affecting industry in the 1960s and beyond is the relative dearth of management schools in Britain when compared with the United States. Sampson notes that management as an academic study had begun at Pennsylvania University as early as 1881, but no equivalent existed in Britain:

“Early in 1963, a ‘Neddy’ report recommended a management school in the interests of productivity, and later in the year the Robbins report on higher education proposed “at least two major postgraduate schools associated with a well established institution”. [...] [Lord Franks’s] report, published three months later, and almost immediately accepted, advocated two new schools, one at Manchester University and one in London, jointly run by the London School of Economics and Imperial College.”⁷⁸

1.49 Provision of the MBA degree – as it eventually became, after starting as an MSc – at these and other universities would obviously not alone improve the quality of British management to the highest levels of international competitiveness; Sampson noted that MBA-status had waxed and waned in the US itself even during the 1960s. As with all degrees, the calibre of teaching would be highly institutional-specific as Business schools proliferated across the UK over the next 40 years. But as business education expanded, it helped management in UK companies develop a common language and analytical tools. A manager in a relatively small firm would be better placed to identify corporate shortcomings to an extent that might only have been possible previously for those with experience gained in large corporations or by hiring external consultants.

1.50 As business education evolved in the UK, a number of business schools developed programmes aimed directly at smaller or more entrepreneurial firms. By the mid-1990s, management schools were also established at Oxford and Cambridge, not always without difficulty, as the first Dean of the Saïd Business School at Oxford found:

“It is difficult or impossible for people outside Oxford, used to normal management processes, to deal with those who hold executive titles but who

do not have executive functions. Outsiders expect to negotiate agreements with responsible officers on the basis that the results of such negotiation will be honoured. But this expectation cannot be satisfied, because the individuals who conduct the negotiations lack appropriate authority. This situation was a constant source - at first of incomprehension, then of frustration - to Mr Saïd, who spent five years trying to persuade the University to accept a £20m gift.”⁷⁹

(In the 2005 Economist Intelligence Unit survey, the Judge Business School in Cambridge ranked 20th in the world, the Saïd at Oxford 31st. In the 2006 Financial Times ranking of global MBA programmes, the Saïd ranked 20th and the Judge 35th; London Business School, in fifth place, was the highest-rated non-US school.)

1.51 It is hard not to conclude that, taken together, the numerous contributions to the professionalisation of management in Britain over the past 40 years have significantly helped the performance of the corporate sector. It is equally hard to imagine a spokesman for directors as a breed commenting today in the same terms as the Director-General of the Institute of Directors, Major Sir Richard Powell, did in the early 1960s:

“There are three different classes in industry – labour, managers and directors [...] The board itself doesn’t have to be experts: technicians and accountants should be available, to be consulted by the board. We believe that directors are a kind of aristocracy: they should be men of parts, and they should have interests outside their business. Directors have become noticeably less selfish in the last seven years: it’s easier now to find men to join committees [...] you could say we were a gigantic Old Boy network.”⁸⁰

1.52 Parallels for the UK’s need in the 1960s to move to greater professionalism in management education can be seen both in the creation in the late 1950s of INSEAD at Fontainebleau by European graduates of Harvard Business School and more recently in the action by leading German corporations to establish the European School of Management and Technology⁸¹, with campuses in Berlin, Munich and Cologne. Just as until recently in Britain either work experience (such as a graduate induction programme) or an accountancy qualification was deemed an adequate business qualification, so in Germany university courses leading to the degree of *Diplom-Kaufmann* would have been considered sufficient for a corporate career. Each country may still infuse its own culture in its MBAs, though:

“This tendency [to look for ‘German’ solutions] may

77 Kerr (2001).

78 Sampson(1965) p519.

79 John Kay, 25 October 2000. <http://www.johnkay.com/political/167>

80 Sampson(1965) pp566–7, citing Daily Mail 9 November 1961

81 www.esmt.org/en

be strengthened by the grand opening on February 3rd of a new European School of Management and Technology (ESMT), based in Berlin and backed by 25 leading German companies and associations. The school will sing the virtues of long-term value creation and building companies, rather than short-term dictates of shareholder value, says Derek Abell, ESMT's founding president.⁸²

European Experience and the Lisbon Agenda

1.53 A common response to the limited scope of the domestic UK market when compared with the US has been to look to pan-European initiatives. In both the 1960s and the 1990s, these were characterised by political ambition rather than commercial realism. The programme sketched out by Shanks in 1967 became the pattern for later efforts; a short extract gives the flavour:

“A genuine European Technological Community, therefore, would need to embrace the following attributes:

- The establishment of genuinely European companies, through harmonization of company law and taxation, including legislation on patents, mergers and monopolies etc.
- Co-ordinating policies towards US investment and the degree of protection to be accorded to Europe's science-based industries. Such policies should not be too protectionist. Britain and the continent have much to gain from the inflow of US capital and the import of US know-how, both technological and managerial. We should not cut ourselves off from the benefits of US expertise; equally, however, we should not allow ourselves to be swamped by it.⁸³

1.54 Numerous goals were identified, without consideration of how in detail they might be implemented. Yet the issue of protectionism was not to go away:

“In the aftermath of the referendum defeat, the French establishment talked itself into a state of advanced paranoia because of rumours of a bid for Danone, a French food firm, by PepsiCo, an American one. It produced a list of 11 ‘strategic sectors’ it thinks should enjoy protection from foreign takeover.⁸⁴

1.55 *Plus ça reste la même chose*. In March 2000, EU heads of government meeting in Lisbon agreed to make the EU “the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and

greater social cohesion”.⁸⁵ The aims included not just accelerating the transition to a knowledge driven economy, but also modernising the European social model and taking account of environmental priorities. The timeframe envisaged was ten years, and the key policy objectives included:

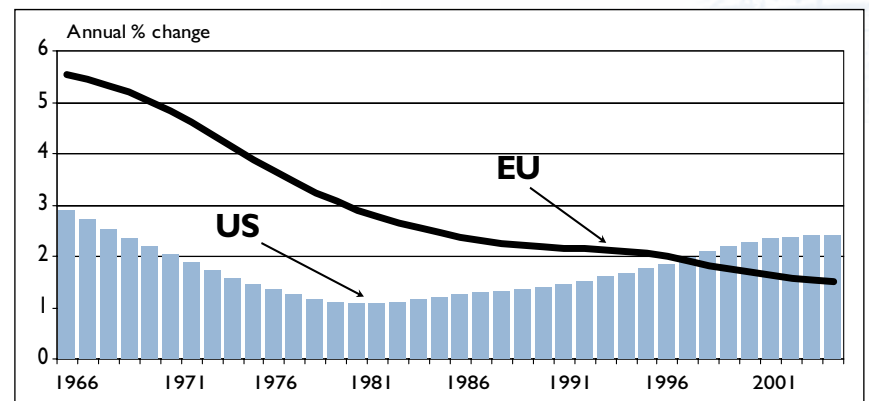
- A target investment in R&D of 3% per annum across the EU
- A reduction in red-tape to promote entrepreneurship
- An employment rate of 70% (60% for women)

1.56 The Lisbon Agenda was meant to represent a turning point in European innovation, countering low productivity, stagnant growth and high unemployment. However, progress was slow. An interim review carried out under the chairmanship of Wim Kok, a former Dutch prime minister, which concluded that the poor results to date were due to “an overloaded agenda, poor coordination and conflicting priorities”⁸⁶.

“Whether in patent applications, numbers of scientific researchers, universities’ standing in international rankings, numbers of Nobel Prize winners or references in scientific papers, Europe trails the US. The opportunity to create global standards is insufficiently seized. The European IT sector represents 6% of European GDP compared with 7.3 % in the US, while European investment in IT capital goods has consistently lagged behind the US by around 1.6 % of GDP in the recent past.”⁸⁷

1.57 Responding to the report, the European Commission decided that the environmental and social aspects of the Lisbon Agenda should no longer be a priority. The mixed priorities had contributed to continuing decline in labour productivity in the EU when compared with the US, as the following figure from the Kok Report⁸⁸ shows:

Figure 1-4: Labour productivity per hour growth (moving average)



Source: AMECO database - http://ec.europa.eu/economy_finance/indicators/annual_macro_economic_database/ameco_en.htm

82 The Economist, 4 February, 2006, p65.

83 Shanks(1967) p177.

84 The Economist, 4 March 2006, pp69–70.

85 Kok (2004) p9.

86 Ibid. p6.

87 Ibid. p20.

88 Ibid. p15.

Table 1.2: Relative performance of the old Member States according to the structural indicators on the shortlist

Levels ⁽¹⁾	GDP per capita (PPS, EU-15 = 100)	Labour productivity per person employed (PPS, EU-15 = 100)	Employment rate (%) ⁽²⁾	Employment rate females (%) ⁽²⁾	Employment rate of older workers (%)	Educational attainment (20–24) (%)	Research and development expenditure (% of GDP)	Business investment (% GDP)	Comparative price levels (EU-15 = 100)	At-risk-of-poverty rate (%)	Long-term unemployment rate (%)	Dispersion of regional employment	Greenhouse gas emissions (index base year = 100)	Energy intensity of the economy	Volume of transport
	2003	2003	2003	2003	2003	2003	2003	2003	2002	2003	2003	2003	2002	2002	2002
AT	111.4	96.4	69.2	62.8	30.4	83.8	2.2	20.3	102	12.0	1.1	3.1	108.5	146	120
BE	106.6	118.4	59.6	51.8	28.1	81.3	2.2	17.9	99	13.0	3.7	7.7	102.1	214	100
DE	98.8	94.3	65.0	59.0	39.5	72.5	2.5	16.3	104	11.0	4.6	6.0	81.1	165	102
DK	112.9	97.8	75.1	70.5	60.2	74.4	2.5	18.2	131	10.0	1.1	-	99.2	123	85
ES	87.3	94.8	59.7	46.0	40.8	63.4	1.0	22.1	82	19.0	3.9	8.9	139.4	229	137
FI	100.6	98.6	67.7	65.7	49.6	85.2	3.4	15.3	123	11.0	2.3	6.1	106.8	272	95
FR	103.8	113.7	63.2	57.2	36.8	80.9	2.2	15.9	100	15.0	3.5	5.0	98.1	187	96
EL	73.0	90.3	57.8	43.8	42.1	81.7	0.6	21.8	80	20.0	5.1	3.6	126.5	258	127
IE	121.7	119.7	65.4	55.8	49.0	85.7	1.2	19.7	118	21.0	1.5	-	128.9	164	133
IT	97.8	103.6	56.1	42.7	30.3	69.9	1.1	16.5	95	19.0	4.9	17	109.8	184	103
LU	194.6	132.2	62.7	52.0	30.0	69.8	1.7	15.0	100	12.0	0.9	-	4.9	198	110
NL	109.9	95.2	73.5	65.8	44.8	73.3	1.9	16.5	102	11.0	1.0	2.4	100.6	202	97
PT	68.3	63.5	67.2	60.6	51.1	47.7	0.9	19.1	74	20.0	2.2	3.9	141	254	126
SE	105.6	96.5	72.9	71.5	68.6	85.6	4.3	12.6	117	9.0	1.0	4.3	96.3	224	90
UK	108.9	101.9	71.8	65.3	55.5	78.2	1.9	14.6	108	17.0	1.1	6.0	85.1	212	86
EU-25	91.2	93.1	62.9	55.1	40.2	76.7	1.9	16.8	96	15.0	4.0	13.0	91.0	210	101
EU-15	100.0	100.0	64.4	56.0	41.7	73.8	2.0	16.7	100	15.0	3.3	12.0	97.1	191	102
US	140.3	121.6	71.2	65.7	59.9		2.8		113				113.1	330	91
TARGET 2005			67.0	57.0											
TARGET 2010			70.0	60.0	50.0		3.0						92.0		

Source: Kok (2004) p48. ¹ Levels for the year indicated or for the last available year. ² Employment data US:source OECD.

1.58 The Kok Report highlighted the structural rather than cyclical shortcomings of Europe as a whole in R&D investment when compared with the US or emerging Asian economies (see Table 1.2). With R&D expenditure of 2.8% of GDP in 2003, the US was ahead of every EU country except Sweden (4.3%) and Finland (3.4%). It is perhaps not surprising that these two countries should be leaders in such sectors as mobile telecoms identified in the report as sectors where Europe has an advantage:

“Fortunately, there are some strengths too. Europe produces nearly twice as many science and engineering graduates as the US. There are individual sectors, such as civil aerospace, mobile phones and power engineering, where Europe is strong. Too much of US technological advantage is concentrated in defence and defence-related sectors. What is now required is a recognition of the importance of the knowledge society to Europe’s future and a determination to build it.”⁸⁹

89 Kok (2004), p20.

High Value Manufacturing?

1.59 The Kok Report contains upbeat sections concerning the interaction of industry with external research. However, its approach may be overly optimistic both (a) as to the extent of the integration of those regions (just how supportive is the public authority, how robust the transport infrastructure and how able are the institutions to provide funding?) and (b) as to the extent of the integration of the knowledge economy with more traditional industry:

“**Creative interaction** between universities, scientists and researchers on the one hand and industry and commerce on the other, which drives technology transfer and innovation, is necessarily rooted in the close physical location of universities and companies. There is already ample evidence around the world that **high-tech clusters are built on this interaction**, but ‘ideopolises’—for example, Helsinki, Munich and Cambridge — go further. They have an array of other supporting factors — notably a sophisticated communications and transport infrastructure, financial institutions willing to

provide the necessary risk capital to entrepreneurs and specialists in technology transfer, supportive public authorities that facilitate the network structures driving creative interaction—and are attractive environments for knowledge workers. ‘Ideopolises’ are emerging as the cities at the heart of dynamic, high-growth knowledge-based regions.”⁹⁰

1.60 While local difficulties (such as the A14 Cambridge ring road) may eventually be resolved, it is less clear that in Britain at least the integration of ‘old’ and ‘new’ economies can be readily achieved. Given that Britain was first in to the industrial revolution, it is not surprising that it should also be in the vanguard of de-industrialisation as manufacturing contracts as a proportion of GDP and services expand; after all, Britain collectively gave up a mercantilist understanding of its economic strength (seeing capital as fixed, considering trade a zero-sum game) in favour of concentrating on its comparative advantages in finance, design, the creative industries and niche manufacturing. Schumpeter recognised the constant change inherent in capitalist economies (“This process of Creative Destruction is the essential fact about capitalism. It is what capitalism consists in and what every capitalist concern has got to live in.”⁹¹). As the British economy was restructured in the 1980s and 1990s, the loss of manufacturing was initially seen as a manageable, even self-stabilising process:

“The crowding-out effect of North Sea oil [...] did hasten the decline in manufacturing output as a share of GDP. But it did no more than reinforce a long-standing trend. Manufacturing industry’s share of total output fell between 1970 and 1977 from 34 percent to 30 percent, a period when North Sea output was negligible and under governments which attached a special importance to this sector. The share then fell further before stabilizing at around 23 per cent in the later 1980s.”⁹²

1.61 More recently, as manufacturing has fallen to about 17% of UK GDP, a consensus has emerged around the proposal that the decline was not a problem because (a) the higher value-added elements of research, development and design would be still undertaken in Britain (b) volume manufacturing would be sub-contracted abroad, for instance to China and (c) where necessary, ‘higher value manufacturing’ would continue to be undertaken in the UK. A major review of UK competitiveness was commissioned by the Economic and Social Research Council (ESRC) and the DTI in 2003 (*UK Competitiveness: moving to the next stage*)⁹³ and undertaken by Professor Michael Porter and Christian Ketels of the Institute of Strategy

and Competitiveness at Harvard Business School; the key findings were that to remain competitive, the UK’s manufacturing sector must move from competing on relatively low costs of doing business to competing on unique value and innovation. This requires both physical investment and upgrading of company strategies—business model improvement.

1.62 The Institute for Manufacturing recently analysed the policy drive towards high value manufacturing:

“UK companies are being encouraged ‘... to move up the value chain and to reap the benefits of high-skilled, knowledge-intensive manufacturing operations’ while competing on ‘... unique value and innovation.’ At the core of this strategy is the concept of a high value manufacturer. Companies who are able to move up the value chain are considered to be high value, and this is assumed to be what is best for companies and the countries in which they are located.”⁹⁴

1.63 Highlighting that “[u]nfortunately there is no accepted definition of a high value manufacturer or high value manufacturing (HVM), making this high value vision hard to achieve or to support in policy”⁹⁵ the report also noted that manufacturing and production are not the same and that analysis is beset by measurement and definition issues (not only are SIC codes a blunt instrument but delivery mechanisms may have a perverse effect as well: software delivered on a disc will count as manufacturing but software delivered over the internet will not). It concluded that “high value manufacturing could only be defined if the question of ‘value to whom?’” is addressed. Though the issue is normally only considered in terms of “what is good for the company financially [...] different stakeholders may well make judgments about value in non-financial terms.”⁹⁶

1.64 However, it is not evident that—even in terms strictly of financial returns—the trends in UK manufacturing are moving in the right direction, as the ESRC’s comparison of UK manufacturing value added with that of major OECD countries shows in Figure 1-5. Numerous culprits have been suggested for the poor performance in recent years of UK manufacturing, with one of the likeliest causes being poor labour productivity induced by poor management. As McKinsey & Co noted,

“The real culprit is poor labour productivity, where the gap between the UK and its rivals is even more pronounced, and continuing to widen, increasing from a 27 per cent to 55 per cent gap with the US, a 17 per cent to 29 per cent gap with Germany and a 15 per cent to a 32 per cent gap with France [...] If the gap was closed, the sector’s performance would

90 Kok Report (2004) pp 20-21, emphasis added.

91 Schumpeter (1942).

92 Lawson(1992) p195.

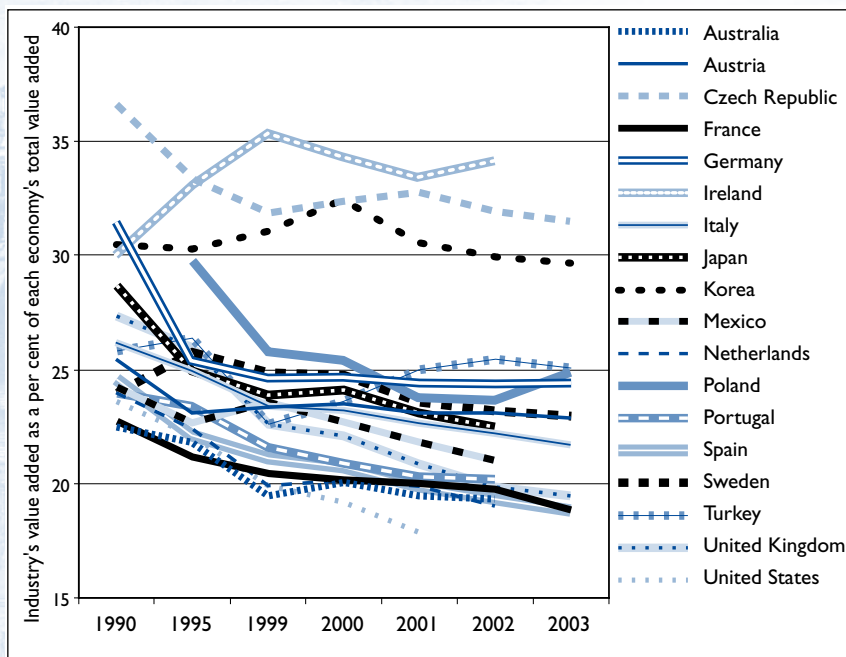
93 http://www.esrcsocietytoday.ac.uk/ESRCInfoCentre/Images/Paper%203_Porter_and_Ketels_Published_tcm6-5508.pdf

94 Livesey (2006) quoting DTI (2002) and DTI (2003b).

95 Ibid.

96 Ibid.

Figure 1-5: Value Added of Manufacturing Sector to Selection of OECD countries 1990–2003



Source: Economic and Social Research Council (www.esrc.ac.uk), UK Fact Sheets.

be on a par with its competitors: output would go up, financial returns would improve and the sector would attract more investment, reinforcing a new, virtuous cycle of growth [...] closing the gap could generate a windfall of some £70 billion in pre-tax returns to the UK economy. Interestingly, the labour productivity gap has nothing to do with the quality of the UK workforce. Foreign-owned companies manufacturing in the UK, drawing from the same pool of talent, working within the same regulatory framework and constrained by the same scale effects as their UK-owned competitors, are more productive than UK-owned companies.⁹⁷

1.65 The management revolution noted in the context of business education in the UK has impacted some sectors far more than others. Several further caveats should be entered to the belief that in the era of the 'knowledge economy' Britain is adequately served by relying on its emerging base of high-value manufacturing, however defined. First, as Professor Porter's analysis for the ESRC shows, the manufacturing base in Britain may not be sufficient on its own to support research-intensive locations such as London, Edinburgh, Oxford or East Anglia. Although many mass-manufacturing activities are better undertaken in countries with a lower cost base and flexible capacity, where new technology is being commercialised overseas production does not take account of other factors:

97 McKinsey & Co (2002), p5. "The dismal standard of literacy and education in the UK is one of the key reasons that the economy's efficiency has plunged in recent years, according to the Chief Economist at the Organisation for Economic Cooperation and Development" Daily Telegraph, 4th August 2006.

- The risk that despite confidentiality agreements, intellectual property may 'leak', not necessarily within the country of manufacture itself.
- The intangible 'know-how' developed through constant modifications of product and process as a dialogue between designer and manufacturer is lost. Where all parties to the value chain are co-located, informal co-operation on improvement is greatly facilitated to the point where it becomes an intrinsic competitive advantage, part of the 'glue' of a cluster and the inherent competence of a commercial firm.
- It is not clear that 'remote manufacturing' capabilities (including control from Britain of machine tools located overseas, simulated set-up of overseas machinery in Britain and video conferencing) are likely to be an adequate substitute for domestic production, any more than distance learning can fully replace face-to-face tuition. Since high-value manufacturing is at least as much about service as about product provision, it is not surprising that it should suffer from 'Baumol's Disease': services sectors are resilient to productivity growth because their inherent nature makes productivity improvements less likely than in the goods-producing sectors of an economy⁹⁸.
- Over time, overseas manufacturing locales are eminently capable of developing the research and prototyping capabilities on which leading centres within the British knowledge economy currently rely: "As lower cost economies become more capable of carrying out high quality research and development, the UK will have to aggressively pursue its strategy of moving up the value chain to compete on 'unique products and services.' We will need to compete at all stages of development and exploitation if we wish to retain our position as a leading economy at the forefront of technology developments"⁹⁹.
- In theory, financially successful firms can buy in technical competences, including manufacturing of technology-based products, by using retained earnings, highly-rated shares or low-coupon debt. However, informal discussions with acquisitive companies in Silicon Valley suggest that a sound base of in-house development expertise is required for such companies (a) to identify suitable targets and (b) to integrate both the technology and the personnel within its market strategy. Without such absorptive capacity, patent or corporate acquisitions risk being merely expensive trophies.

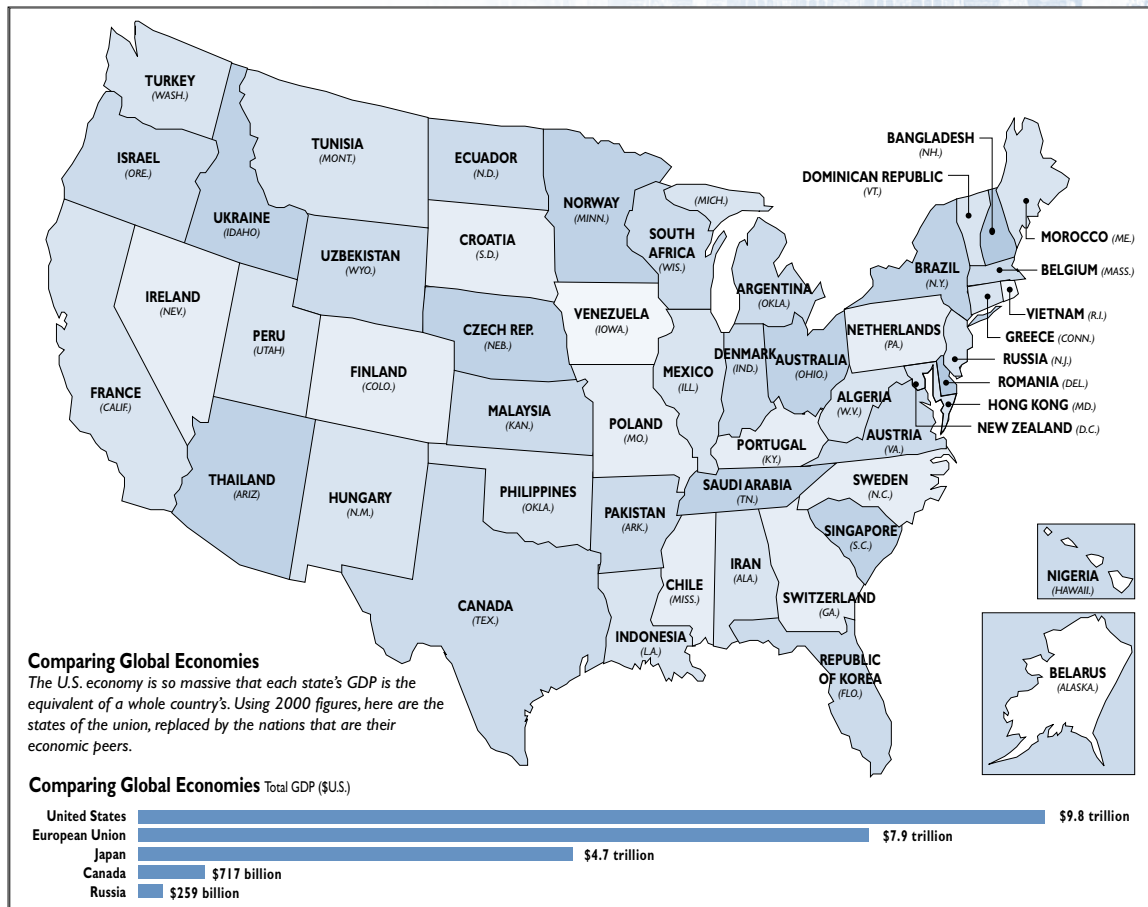
Between Markets and National Champions

1.66 In *Where are the big gorillas: high-technology entrepreneurship in the UK and the role of public policy?* Sir Geoffrey Owen identified four institutional advantages for the US and analysed how the UK has

98 Baumol (1967).

99 Livesey et al. (2006), p5.

Figure 1-6 Comparing scale of US with other economies



Source: UK Trade and Investment, www.uktradeinvest.gov.uk.

progressed in aligning itself on each:

- “a large, competitive domestic market”
- “a highly developed financial system which ensures that entrepreneurs with sound projects have access to capital”
- “generous government support for basic science”
- “a well-funded university sector responsive to the needs of industry.”¹⁰⁰

1.67 He concluded that substantial progress had been made on ensuring competitive domestic markets and in providing access to finance. On the third, government has lifted its spending on the science base from £4.2bn in 2004 – 05 to £5.4bn in 2007 – 08. Universities have already been discussed.

1.68 However, despite undoubted progress Britain still does not have the domestic scale to produce ‘big gorillas’. The largest UK biotechnology firm by market capitalisation in 2004 was Acambis (27th in the world) and Cambridge Antibody (28th). “Vodafone is the only genuine British owned ‘big gorilla’ in the telecoms/information technology sector”¹⁰¹, though even its success has proved fragile, especially after writing off

up to £28bn of goodwill relating to its Mannesmann acquisition.¹⁰²

1.69 It is doubtful whether the UK could ever compete on its own in terms of scale other than in exceptional circumstances. No one region of the UK has both a sufficient science and entrepreneurial base on the one hand and a large enough pool of skilled labour and suitable premises to emulate the clusters of Northern California or around Microsoft in Redmond, WA. Infrastructure issues alone—housing, transport, schooling—make the rapid growth of any one UK cluster to the proportions of the leading technology regions of the US highly improbable. To take the example of the Cambridge cluster alone:

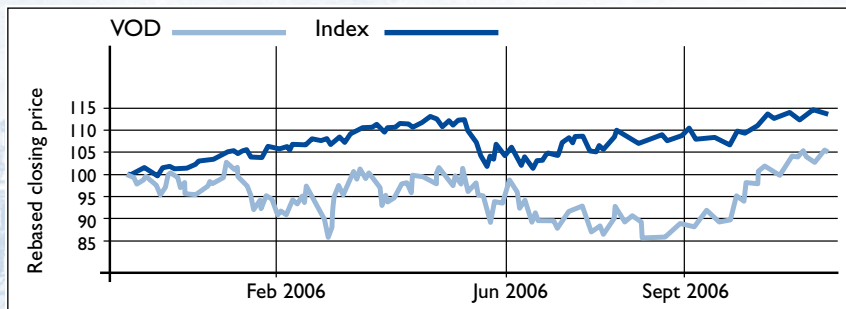
- The largest technology-related firms individually employ a few hundred staff (ARM has 1,375 employees, Autonomy 318, CSR 688 and CDT 119); each had revenues in the latest reported year below \$500m.
- By contrast, Microsoft employs 61,500 worldwide (29,400 around Redmond), Apple 14,800, Cisco 38,400, Oracle 49,800, Intel 99,900, Sun 31,000 and Genentech 9,500; Genentech apart, each had revenues above \$10bn.

100 Owen (2004) p35.

101 Owen (2004) p25.

102 ‘Vodafone row claims see Gent quit’ <http://news.bbc.co.uk/1/hi/business/4799646.stm> accessed on 18 June 2006.

Figure 1-7: Vodafone share price performance to 16 June 2006



Source: London Stock Exchange - www.londonstockexchange.com

- The total committed capital available to all Cambridge-based venture funds in the Summer of 2006 is just over £500m¹⁰³.
 - In 2004 – 05, a handful of Sand Hill Road venture firms individually raised funds of a similar amount, for instance: Menlo Ventures (2005) \$1,200m; Kleiner Perkins (2004) \$400m; Benchmark Capital (2004) \$400m; Mayfield Fund (2005) \$375m; US Venture Partners (2004) \$600m; Versant Ventures (2005) £400m.
 - And success breeds success. The sheer scale of entrepreneurial activity in Silicon Valley means that there are far more experienced, serial entrepreneurs there than in the UK: “Among 2,492 founders of firms during 1992–2001, many were previously employed at established companies or research institutions in the region: 117 from HP, 101 from Sun, 94 from Apple, 82 from IBM, 76 from Intel, 73 from Oracle and 71 from Stanford.”¹⁰⁴
- 1.70 The 1960s and 1970s witnessed a policy drive to ‘national champions’ such as ICL; for the reasons set out above, this policy did not work, though it still finds supporters elsewhere in the European Union. More recently, market-oriented policies in the UK have been highly successful in encouraging the formation of entrepreneurial start-ups to commercialise technology. Nevertheless, the limitations of the UK market on its own—limited access to risk capital, limited numbers of technically-qualified employees and, above all, limited domestic markets—suggest that at both the firm and the policy level strategies dependent on ‘building a UK Microsoft’ (a commonly-used phrase) have the narrowest chances of succeeding. Nor does the European experience of R&D investment or technology commercialisation inspire confidence that a solution can be found at an EU-level. The UK technology economy itself is really a set of regional economies (but not necessarily those which have been defined by the Government and whose economic progress is driven by a Regional Development Agency). Despite numerous formal and informal attempts to straddle various economic sub-regions together (Central Innovation Network, Oxford to Cambridge Arc), they remain separate not just because

¹⁰³ Herriot and Minshall (2006). Note: excludes 3i.

¹⁰⁴ Public Policy Institute of California (2004). For the full data see Zhang (2003).

of the ‘narcissism of small differences’ but because each sub-region can function well as a cluster and then needs access to major international, rather than national, markets and expertise.

The Israeli Model

- 1.71 International technology markets already provide one successful example of a technology-rich economy that does not depend on either building national champions or relying solely on domestic or regional markets (though it must be considered in light of its size and historical context). Having established a thriving venture capital industry through the Yozma Fund (1992–93) and encouraged both general entrepreneurship and the market-orientation of scientific immigrants during the 1990s, Israel pioneered a short-cut to internationalisation through the re-registration of leading technology companies in Delaware or California. Neighbouring states offered little or no opportunity for exports, but individual firms exploiting application-oriented technology could rapidly enter international markets with far greater potential than Israel alone could provide with a population of 7 million. R&D was typically kept in Israel, but marketing and funding were moved to the US. Sourcing US investors also opens the door to an extensive network of industry contacts as development partners and reference customers.¹⁰⁵
- 1.72 With this Israeli model, investors and entrepreneurs benefit for obvious reasons as individual companies grow. The economy as a whole benefits as not only is R&D kept at home but the cycle of rapid commercialisation develops management teams with an international focus, an application mindset and a clear understanding of the primacy of markets over technology *per se*.¹⁰⁶ Both investment and know-how flow back to Israel. A recent example is Saifun (See the following box study).
- 1.73 A small number of examples can already be found of European companies that have trodden a similar if subtly different path:
- SAP identified a market niche in enterprise software not already dominated by US players and perfected it before entering the US market.
 - Skype was formed in 2003 by two Scandinavian entrepreneurs, received funding from both US and European venture firms (Draper Fisher Jurvetson, Index Ventures) in 2004 and was

¹⁰⁵ Gill *et al.* (2002). Effecting the transfer is taxing in people management terms. As the chairman of one established Israeli fund put it to us: “We have learned from experience that you should employ an Israeli CEO who is at home in the US, rather than a US CEO – who will not understand Israeli culture. But we should also skip over the first CEO we appoint in the US and employ the second one straightaway instead; we always make a mistake with the first.”

¹⁰⁶ As is illustrated by the firms shown in Table 1.3.

sold to eBay in September 2005 for \$2.6bn.

- Autonomy Corporation plc, based in Cambridge, has the look and feel of a US company, with dual headquarters in Cambridge and San Francisco.
- Cambridge Silicon Radio, the leader in the Bluetooth market, was a spin-out from Cambridge Consultants, and now reports its results in US\$.
- ARM, one of the leading semiconductor IP suppliers in the world, is quoted on both The London Stock Exchange and on NASDAQ.
- Micromuse, a network management software company from London, grew to over £140m in annual sales and over £4bn in market capitalisation. Originally founded in 1989 as a reseller, it became a pure play software company in 1997. In 2006 it was acquired by IBM.

UK and European companies can and do develop products and services which disrupt existing markets and create new ones, but they are unlikely to do so by operating solely at a European level.

Table 1.3: Yozma companies that reached IPO/M&A stage

Yozma Companies that reached IPO/M&A stage			
Oramir	Dry Wafer Cleaning	Aquisition	(Applied Materials, NASDAQ: AMAT)
Inspechtech	Automatic Inspection Equipment	Aquisition	(Camtek, NASDAQ: CAMT)
MainControl	Software for Computer resource management	M&A	(MRO: MROI)
X-Technologies	Medical Devices	Aquisition	(Siemens, NYSE: GDT)
Eship	Web Managed Network of Automatic Delivery Machines	Aquisition	(Siemens, XETRA: SIE)
Telegate	Communications Infrastructure	M&A (Terayon, NASDAQ: TERN)	
E-Sim	Internet Simulation Platform	IPO	(NASDAQ: ESIM)
Commtouch	Web-based e-mail	IPO	(NASDAQ: CTCH)
Ligature	OCR software	M&A	(Wizcom)
Ubique	Internet Communication	M&A (America Online, NYSE: AOL)	
Security-@	Web Security	M&A	(Computer Associates, NYSE: CA)
BioSense	Cardiac Systems	M&A	(Johnson & Johnson, NYSE: JNJ)
Instent	Cardiovascular Stents	IPO	(NASDAQ: ININ)
Influence	Urological Technologies	M&A	(AMS, NASDAQ: AMMD)
AG Israel	Microelectronic Systems	IPO	(NASDAQ: AGAI)

Source: <http://www.yozma.com>

Saifun: Israeli Venture Investees and the US Market

Excerpts from press announcement issued by Gemini Israel Fund, November 10, 2005¹

Saifun Announces NASDAQ IPO Valued at Over \$900M at Close of First Trading Day

“We’re pleased to announce the much anticipated IPO for Saifun Semiconductors Ltd. which took place yesterday. The company is now listed on the NASDAQ

exchange under the ticker, SFUN. Saifun raised \$117.5M in a heavily oversubscribed offering. Underwriters for the deal are Lehman Brothers, Deutsche Bank Securities, CIBC World Markets, William Blair & Company and Raymond James. This is one of the biggest IPOs of a VC-backed Israeli company in terms of amount raised and company valuation. At the close of trading on the first day, Saifun was valued at over \$900M.

Saifun is a leading company in the flash memory market, one of the fastest growing sectors of the semiconductor industry. Almost from its beginnings Saifun was widely recognized as one of the most promising private companies in Israel. The company’s customers include Sony, AMD, Fujitsu, Infineon and SMIC among others. Gemini was the first investor approached by the company’s CEO, Boaz Eitan, in 1997. [...] The Saifun technology, which is unique in cell design, process and array architecture, enables two physical memory bits per cell without any floating gate. The very small area per bit and the simplified manufacturing process create the most cost-effective flash solution in the market. More recently, the company has graduated to four bits per cell. [...]”

¹ http://www.gemini.co.il/news_show.asp?id=242. Arguably, by 2006 Israel itself had moved on a stage: “Today’s first customers may well be Japanese or Chinese, not American – and Israeli companies now explore listing possibilities outside the US”, *Red Herring*, 19th June 2006, p37.

Summary

1.74 “It was much bet[ter] than last year,”¹⁰⁷ as *Down with Skool* memorably put it. Looking back over the period that began with the creation of the Ministry of Technology, with its belief in central planning, its focus on national champions and its reliance on high taxation and marginalisation of entrepreneurs, Britain has made considerable progress in the funding and commercialisation of technology. The interdependencies within the main knowledge economy avatar, the American system, are better understood, its individual components—venture capital, incubation, share options, low taxation, angel funding, basic scientific research—more robust than before. At the macro level, Britain is no longer the sick man of Europe but one of its most dynamic economies. Past mistakes and challenges have been recognised and are being met.

1.75 However, in other ways, the UK is under-prepared for the new challenges to be faced in the next decades. Britain can still not compete with the US in terms of market scale, access to risk capital, experienced entrepreneurs and sector strengths—the majority of software development still takes place in the US; Britain cannot even compete with its direct counterparts in Europe in investment in basic research, applied R&D, patenting and the conversion of research to innovation. Aside from the US, Britain’s other main current and future competitors are no longer the European pacesetters of the post-war era, but emerging giants, mainly in Asia: China spent \$60bn on R&D in 2002, employed 743,000 R&D researchers and 43% of its tertiary sector students were enrolled in science and engineering; India spent \$19bn, employed 150,000 researchers and 25% of its students studied in science and engineering¹⁰⁸.

1.76 During his brief spell as Secretary of State for Trade and Industry in 1998, Peter Mandelson was responsible for the publication of one of the most inspiring White Papers on innovation—*Our Competitive Future: Building the Knowledge Driven Economy*. After noting strengths in areas such as basic science, pharmaceuticals and media, the White Paper continued:

“Yet Britain suffers long-standing shortcomings, which still hold us back. Too many British companies fail to match the performance of their overseas counterparts, not just in terms of productivity but in innovation and quality. We have invested too little in modern plant and machinery, as well as research and development and other intangible assets. Skill levels, including marketing and design skills, are too low across too much of the workforce. Too many British companies have low ambitions. Too few match

¹⁰⁷ Willans and Searle (1953).

¹⁰⁸ www.worldbank.org

If You Can Remember the Sixties....

Parallels and differences between then and now

“If you set up a school and it becomes a good school, the great danger is that’s the place they [the middle-classes] want to go to.” Rt Hon John Prescott MP, Deputy Prime Minister, *Sunday Telegraph* 18 December 2005, interviewed by Susan Crosland, widow of Anthony Crosland:

“It is inconceivable that any German minister for education should have commented *mutatis mutandis* with respect to the *Gymnasien* as did the Rt Hon Charles Anthony Raven Crosland MP (educated at Highgate School and Trinity College, Oxford), Secretary of State for Education and Science 1965–7: “‘If it’s the last thing I do, I’m going to destroy every [expletive deleted] grammar school in England,’ he said. ‘And Wales. And Northern Ireland.’ ‘Why not Scotland?’ I asked out of pure curiosity. ‘Because their schools come under the Secretary of State for Scotland.’ He began to laugh at his inability to destroy their grammar schools.” Susan Crosland, *Tony Crosland*, London 1982, Jonathan Cape, p148

“From now on, the Labour Party was to be the party which understood the modern world and its reality, and could work within it [...] which, in short, had buried Clause Four and everything else which smelt of it [...]” Levin (1970) p227

“The Board of Trade had an unfortunate history in the late fifties and early sixties.” Shanks (1967) p110

“Ce qui menace de nous écraser n’est pas un torrent de richesses, mais une intelligence supérieure de l’emploi des compétences. [...] Les unités lourdes de l’industrie américaine, après s’être informées des particularités du terrain, manœuvrent actuellement de Naples à Amsterdam avec l’aisance et la rapidité des blindés israéliens dans le Sinaï.” Jean-Jacques Servan-Schreiber, *Le Défi américain*, Denoël, Paris, 1967, p41 ¹

I “We risk being crushed not by a torrent of riches but by an intelligence superior in deploying its skills. The heavy units of American industry, having studied the individual character of

world best practice.”¹⁰⁹

1.77 As the Tony Blair acknowledged recently in connection with the former Secretary of State responsible for the White Paper, “a lot done, a lot left to do”.¹¹⁰

But without a ‘Sputnik moment’, crystallising the challenge for the UK in this decade as the US was galvanised in the 1950s, it is difficult to see the necessary vision and energy being dedicated to maintaining the momentum.

¹⁰⁹ DTI (1998), paragraph I.10.

¹¹⁰ Hansard 30th November 2005, column 263. <http://www.publications.parliament.uk/pa/pahansard.htm>.

“Organizers are also fighting some skeptics who maintain that Quaero could waste taxpayers’ money in academic research that produces no commercial benefit. The project, conceived in April by President Jacques Chirac of France and Gerhard Schröder, then the chancellor of Germany, is an attempt by two of Europe’s largest economies to develop a local challenger to Google, the California-based search engine, which spent \$327 million on research and development in the first nine months of 2005. In a speech this month laying out his 2006 agenda, Chirac spoke to those concerns, saying: ‘We must take up the challenge posed by the American giants Google and Yahoo. For that, we will launch a European search engine, Quaero.’” *International Herald Tribune* 18th January 2006

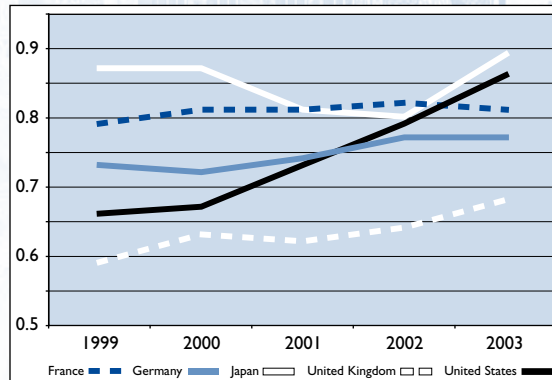
“There is a fairly general feeling among scientists, especially in industry, that they are usually undervalued in relation to others with less obvious qualifications. Phrases like ‘backroom boys’, and ‘on tap but not on top’ are themselves indicative of a feeling which is widespread and has many ramifications.” *Memorandum to the Minister for Science from the Advisory Council for Scientific Policy*, May 1963, cited in Sampson (1965) p386

The 1960s even sprouted its own Richard Dawkins, the more eminent Nobel prize-winner Dr Francis Crick, who objected to private funds being subscribed for the construction of a chapel at the newly-founded (1960) Churchill College in Cambridge: “To the astonishment of many who believed that scientists were rational, Crick refused to be relieved of his embarrassment in this manner, and insisted on resigning his Fellowship if the chapel were built, even at private expense [...] Crick, perhaps fearing that cowed monks and wimpled nuns would creep to his room in the dead of night and drag him into the chapel, there to practise upon him some hideous rites ranging from baptism to crucifixion, insisted on resigning if the chapel were built. It was, and he did.” Levin (1970) pp19–20.

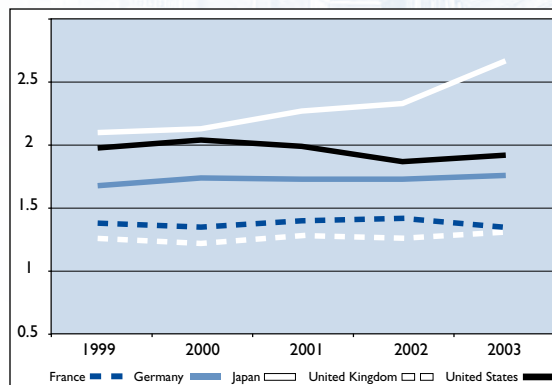
each territory, now manoeuvre with the ease and speed of Israeli armoured cars in the Sinai.”

Snapshots of the UK

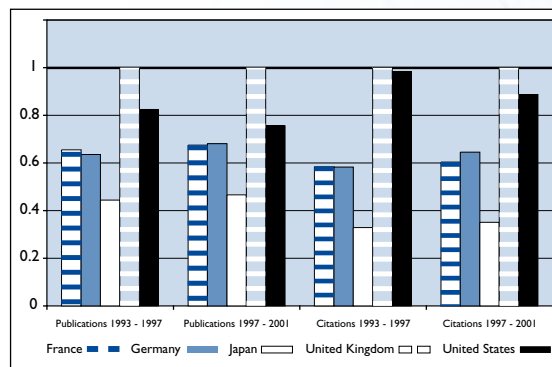
Government spending on R&D (% of GDP)



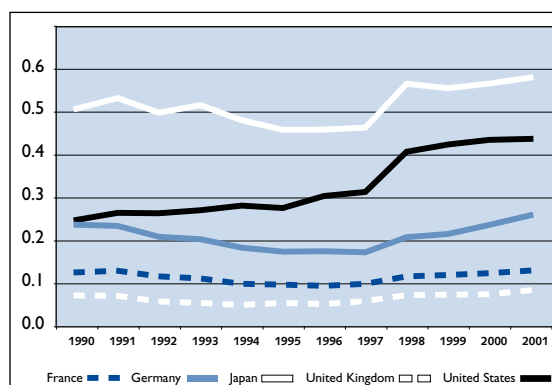
Business spending on R&D (% of GDP)



Publications and citations per capita (UK=1)



Ratio of US patents to papers



Source: Livesey et al. (2006)

Venture Capital and Angel Investment

"It has been represented to us that great difficulty is experienced by the smaller and medium-sized businesses in raising the capital which they may from time to time require, even when the security offered is perfectly sound. To provide adequate machinery for raising long-dated capital in amounts not sufficiently large for a public issue, ie amounts ranging from small sums up to say £200,000 or more, always presents difficulties."

Macmillan Committee 1931¹¹¹

"A few months earlier the Industrial and Commercial Finance Corporation [...] had been established under Bank of England auspices with the joint-stock banks as conscripted rather than enthusiastic shareholders. The new institution was intended to fill the 'Macmillan gap'. This had been identified by a committee of enquiry under a Scottish law lord which had been set up by the second MacDonald Government and included both Maynard Keynes and Ernest Bevin. The 'gap' related to the difficulty of access to long-term capital experienced by small to medium-sized businesses."

Roy Jenkins ¹¹²

"What kind of new ministry he [Frank Cousins] is building in Vickers House on the Embankment I have no idea. All I know is that he is occupying more and more floors and getting tremendous backing from Harold Wilson, who believes passionately that this new Ministry of Technology has got to succeed if he is going to keep his promise to modernize British industry."

R H S Crossman, Diaries, 14th April 1965¹¹³

Introduction

- 2.1 The UK has the highest levels of both venture capital and business angel activity in Europe. It also has a relatively dense network of business incubators and other initiatives designed to promote the formation of early-stage growth businesses, especially those involved in innovative technology.
- 2.2 Yet there remains a widespread perception that an 'equity gap' persists—some failure in the availability of capital for early-stage growth businesses hampering their successful development and reducing the contribution that they could make to national prosperity.
- 2.3 Successive governments have tried to encourage the UK venture capital industry, and other investors, to address the needs of growth and technology-based businesses— both through tax incentives and, since Labour came to power in 1997, by committing public money to the formation of new venture capital funds focused on public policy priorities.
- 2.4 The UK venture capital industry is often contrasted, usually unfavourably, with the US industry. This has been a preoccupation of the present government, especially the Treasury, which has looked to the US for models of best practice in encouraging the growth of businesses that exploit scientific and technological innovation.
- 2.5 Informal investors, usually lumped together under the banner of 'business angels', have come to be perceived

¹¹¹ Stanworth and Gray (1991) p51. Hugh Pattison Macmillan (1873–1952) '[...] is perhaps best known for his chairmanship of the Treasury Committee on finance and industry (1929–31), which surveyed the nation's financial system in relation to industry. Its report became known by his name although much of it was written by J M (later Lord) Keynes.' '[...] he sat in the case of Donoghue v. Stevenson [1932] AC 562, known as the case of the snail in the ginger beer bottle.' Dictionary of National Biography, <http://www.oxforddnb.com>.

¹¹² Jenkins (1991) p59.

¹¹³ Crossman (1979) p98.

Emergence of Venture Capital – US

Although risk capital had often been provided before (for instance to build railways in Britain during the 1840s), it was not until 1946 and the creation of the American Research and Development Corporation (ARDC) in Boston that a formal venture capital fund first came into existence. In the interwar years, 'family offices' had undertaken one-off high-risk investments (Laurence S Rockefeller co-founded Eastern Airlines in the 1930s, for example). Though some of the most powerful family offices did undertake investment management for other families, this was a largely informal activity, and did not provide opportunities for pension funds or smaller individual investors to become involved in 'venture funding'.

ARDC was ground-breaking in several ways. It could probably only be launched because of an unusual combination of circumstances:

- its promoters—especially MIT President Karl Compton and Harvard Business School Professor General Georges Doriot—were convinced that much of the scientific research undertaken during the war remained to be exploited
- the calibre of the individuals and the academic institutions they represented gave ARDC a head start in pioneering a new concept
- the financial sector in Boston was reasonably sophisticated and some investors were prepared to invest as much pro bono publico as for a commercial return

ARDC initially only raised \$3m of a target \$5m. It nevertheless set a precedent (J H Whitney & Co was set up immediately afterwards, one of whose successful investments would be Minute Maid). It was now possible for relatively small investors, by investing in a pooled fund, to have access to higher risk and potentially higher reward deals previously only open to high net worth investors; the ARDC fund structure enabled risk to be sufficiently spread to comply with SEC regulations. ARDC employed an experienced staff to structure deals, give business advice and organise investees; it also maintained a technical advisory board to provide leads and give assessments.^I Early Investments included the High Voltage Engineering Corporation and Digital Equipment Corporation, both MIT-related.

The context in which venture capital developed in the US is essential for an understanding of the subsequent differences between the US and UK industries. The take-off of venture capital in the US did not occur in an economic or policy vacuum. During the Cold War, the Federal Government invested heavily in military R&D; it also invested indirectly in the health sector. In 1958, the Small Business Administration licensed and helped fund the first Small Business Investment Companies (which have since backed such household names as Intel, Apple Computer, Callaway Golf, JetBlue Airways, Whole Foods Market and Palm Computing), the model behind the recently-announced Enterprise Capital Funds in the UK:

“SBICs are private equity funds that invest in U.S. small businesses that meet size and operational criteria set by the federal government. SBICs are licensed and regulated by the U.S. Small Business Administration (SBA), but privately managed by private sector management teams whose qualifications and business plans are approved in advance in rigorous licensing process. Minimum capital required to form an SBIC—\$5.0 million—must come from qualified private investors. Additional capital—as much as three times the private capital—is then potentially available to each SBIC through SBA by sale of SBA-guaranteed securities on an “as needed” basis to support fund investments and expenses. The private capital is at risk in its entirety before any taxpayer money is at risk and SBA examines SBICs regularly to ensure their financial soundness and regulatory compliance.”^{II}

I Etkowitz (2002) Chapter 8.

II http://www.nasbic.org/about/sbic_history_highlights.cfm, accessed on 5 March 2006

Other policy measures - working with the grain of the market - included:

- Reducing capital gains tax from 49% to 28% (1979) then 20% (1981)
- Amending Incentive Stock Option Act tax so that charges are only incurred when options are sold, not when they are exercised (1980s)
- Amending the Employment Retirement Income Security Act 1974 to allow pension trustees to invest in venture capital within the 'prudent man' and 'safe harbor' rules (1979, 1980)
- Establishing Small Business Innovation Research programmes from 1982: Federal Agencies with external R&D budgets in excess of \$100m were to allocate a percentage of their budgets to small firms
- The Bayh-Dole Act 1980, transferring ownership of intellectual property to universities undertaking government-funded research

And more recently, in the National Innovation Act legislation has been initiated in the US Senate, in response to the National Innovation Initiative Report published by the Council on Competitiveness, to establish the President's Council on Innovation. The bill identifies “three primary areas of importance to maintaining and improving United States' innovation in the 21st Century: (1) *research investment*, (2) *increasing science and technology talent*, and (3) *developing an innovation infrastructure*.”^{III}

From the 1960s, what was to become eventually a much larger venture industry developed along Sand Hill Road in Northern California, around Stanford University, from the engineering department of which Hewlett-Packard had originated in 1939 to exploit a resistance-tuned oscillator. HP was the original 'garage venture' and was mentored by Fred Terman, originator of the 'steeples of excellence' policy at Stanford and a key founder of Silicon Valley, which until the 1970s consisted largely of fruit groves in Santa Clara County. The transformation of the region accelerated following the decision in 1955 of the co-inventor of the transistor, William Shockley, to move from Bell Labs on the East Coast to Palo Alto. In 1958, eight senior engineers left Shockley to form Fairchild Semiconductors; by 1971, 21 of 23 semiconductor firms in Valley were 'Fairchildren' offshoots, including Intel, founded by Gordon Moore.

Venture capital emerged alongside the industries it supported. When in 1964 Sutter Hill Ventures was formed in Palo Alto, its only existing competition was Davis & Rock (Arthur Rock had been an early supporter of Sherman Fairchild) and George Quist^{IV}, who ran the Bank of America SBIC in San Francisco. But in 1971, another ex-Fairchild employee, Don Valentine joined Sequoia Capital^V; in 1972 family offices offered to invest \$4m in Gene Kleiner if he could raise another \$4m, which he did following an introduction to Tom Perkins^{VI} of HP by Sandy Robertson^{VII}. The size of funds raised gradually increased, such that in 1974 Reid Dennis started Institutional Venture Partners^{VIII} with \$19m. Much of the landscape of the modern Menlo Park industry was recognisable. The oil crisis of the mid-1970s was a break on progress, though this was partly offset through benign policy moves discussed earlier.^{IX}

III <http://lieberman.senate.gov/documents/bills/051215niasummary.doc>

IV Founder of Hambrecht & Quist in 1968 (acquired by Chase Manhattan 1999)

V www.sequoiacap.com

VI www.kpcb.com

VII Founder of Robertson Stephens in 1978 (bought by Bancamerica in 1997; closed by FleetBoston 2002).

VIII www.ivp.com/

IX Gupta (2000).

as a critical element in the financing of early-stage growth businesses. Government policy, under both Conservative and Labour administrations, has been focused on encouraging the development of informal investment.

- 2.6 Finally, the UK stock markets, especially AIM, have encouraged investment in growth businesses both because they themselves provide an alternative route for funding and because they offer the prospect of earlier liquidity for investors than the ultimate exit transaction itself – typically sale of the business.

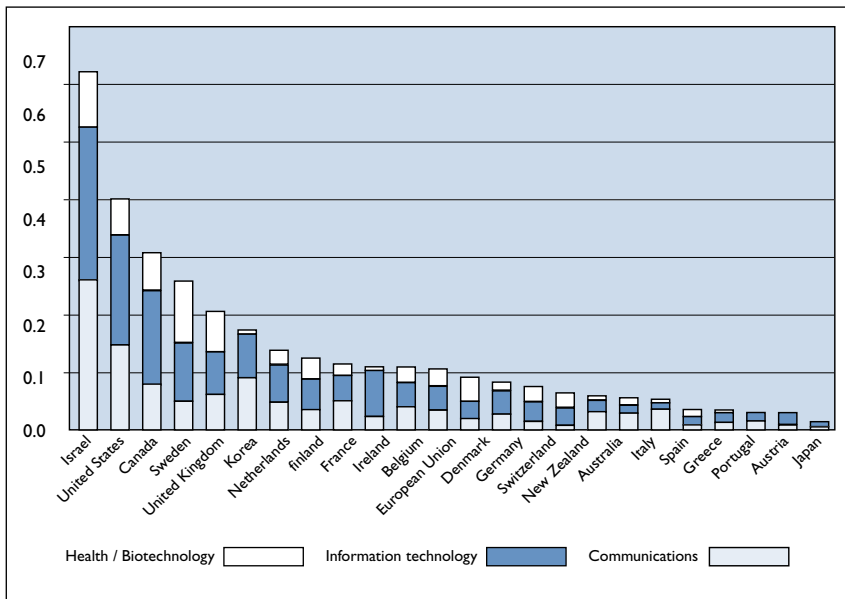
The State of UK Venture Capital

- 2.7 The UK venture capital industry is mature by European standards, but differs significantly from the industry in the US. In 2004, the US National Venture Capital Association (NVCA) members raised an aggregate of £37bn (\$68.4bn) of which £9.4bn (\$17.3bn), i.e. 25%, was by venture capital funds, investing in businesses where the principal purpose is to fund market entry and business growth. In 2005, NVCA members raised \$25bn by way of venture capital (23% of total funds raised). In contrast, of the £3.3bn raised by BVCA members in 2004, £3.0bn, i.e. over 90%, was raised for MBO/MBI funds and of the remainder only £264m, i.e. 8%, was for venture capital. In 2005, the UK figures comprised £24.9bn for late stage investments and only 3% of funds being raised for early-stage technology investment (£926m).¹¹⁴ So the UK industry is both smaller in relation to the size of its economy and much more

focused on later stage investments than its US counterpart.

- 2.8 Global comparisons of national venture capital activity in key technology sectors, relative to overall GDP, show the UK lagging behind the US, Israel, Canada and Sweden but ahead of continental European countries and Japan.
- 2.9 Disappointment about low levels of UK venture capital investment in growth businesses—especially those exploiting science or technology—has been frequently expressed over the years. In a 1990 report¹¹⁵ on barriers to growth in small firms, ACOST, a government advisory panel, commented “In short, the contribution of the venture capital industry to overcoming barriers to growth in smaller firms remains limited.” ACOST attributed this failing to three causes: the relative attractiveness of the risk/reward profile of private equity compared with venture capital; the high levels of return required by venture capital investors; and the limited supply of skilled managers both in the firms receiving investment and in the venture capital firms themselves.
- 2.10 Notwithstanding the internet boom of the late 1990s, when a plethora of new technology investment funds emerged as well as government activity to create new regional and university based funds, the performance of UK technology venture capital investment has been dismal (see Table 2.1). ACOST’s observations about the relative attractiveness of private equity investment remain as true now as they were in 1990.

Figure 2-1: Venture Capital as proportion of GDP – selected industries



Source: OECD (2004)

¹¹⁴ BVCA Report on Investment Activity 2004, 2005 and NVCA Private Equity & VC Fundraising Report Q1 2005, Q1 2006. See www.bvca.co.uk and www.nvca.org.

Type of Private Equity/ Venture Capital Investment	No funds	3 years	5 years	10 years
Non-technology	97	23.2%	14.4%	17.8%
Technology	265	-2.7%	-11.4%	-2.6%

Source: BVCA Private Equity and Venture Capital Performance Measurement Survey 2005. This data is only given up to 2004, and the inclusion of new data may present a slightly less negative picture.

- 2.11 Since Labour came to power in 1997, there has been a concerted effort by the government to address the perceived failure of the investment industry to address the funding needs of high growth businesses, especially those looking to exploit the intellectual assets of the UK science sector. These initiatives have included promoting the creation of early-stage venture capital funds, encouraging investment activity by business angels and developing well-funded technology transfer activities in all UK universities and research establishments.

- 2.12 The government has been instrumental, through the Small Business Service, or SBS¹¹⁶, and the Regional

¹¹⁵ ACOST (1990).

¹¹⁶ SBS is a QUANGO – QUAsi Non-Governmental Organisation

Development Agencies (RDAs), in setting up a network of small venture capital funds investing to promote growth in small firms, both science or technology based and other firms. Since 2000, over £120m has been committed by the SBS and the European Investment Fund in creating a network of nine regional venture capital funds (each with, typically, £20m to £50m under management)¹¹⁷. In addition, it has also been instrumental in the creation of a network of seed funds, the University Challenge Funds, investing in the commercialisation of science originating in universities and government research bodies.

2.13 The UK Treasury, in particular, has looked for examples of best practice to the US. Among several US initiatives to have caught the Treasury's attention is the US Small Business Investment Company (SBIC) programme. Initially structured to provide loan capital to US SMEs, the SBIC mandate was widened to include equity investment in the 1990s. Perceived as a success until 2003, when poor performance data began to emerge from the equity SBICs, the UK Government developed a variant, called Enterprise Capital Funds (ECFs), which received state aid clearance from the European Union in 2005. The first ECFs to be formed were announced in the 2006 budget statement. Table 2.2 gives the investment focus of each of the current six ECFs.

The Origins and Culture of UK Venture Capital

2.14 The foundation of the institutional UK venture capital industry can be traced to the setting up of 3i, as the Industrial and Commercial Finance Corporation (ICFC) on 20 July 1945. The initiative was led by the then private Bank of England as part of a response to the pre-war report of the Macmillan Committee¹¹⁸, which had identified that small firms were constrained from growing by the prohibitive cost of public capital raising. The other shareholders were the London and Scottish clearing banks. Interestingly, no public money was involved.

2.15 In the first thirty years following its foundation, the majority of ICFC's finance was advanced as preference shares and term loans, not least because of the prevailing reluctance of smaller and medium-sized company owners to cede equity¹¹⁹. Even by the 1980s, when equity had become a standard part of most investments, there was little belief that ICFC should have any significant role in the development and strategic direction of the business—other than in its

Table 2.2: Current ECFs

Fund	Focus
IQ Capital Fund	£25m fund which will operate across the Cambridge, Oxford and Bristol areas, but can invest anywhere in the UK. It will focus on technology based SMEs and will make investments of up to £1.5 million. The Fund will be managed by the Cambridge based NVW Brown group.
21st Century Sustainable Technology Growth Fund	£30 million fund which will operate across the UK and focus on high growth companies employing leading edge sustainable technology. E-Synergy Limited, which has close links with the UK's research community and expertise in selecting and backing strong technology in early-stage companies will manage the Fund.
Seraphim Capital Fund	£30 million generalist co-investment fund that will invest alongside leading business angels and other private investors drawing on the deal flow and investment experience afforded by the funds' diverse investor base. The fund will be managed by a coalition of 'business angel' networks and will focus on investments in companies throughout the UK predominantly in the early stages of development.
Amadeus Enterprise Capital Fund	£10 million fund that will focus on seed technology investments. The Fund will be managed by Cambridge based Amadeus Capital Partners who are one of the country's leading specialists in this sector.
Dawn Capital Fund	£37.5 million fund, which includes £25 million of government funding, has been created by a group of successful entrepreneurs and experienced fund managers. The fund will invest throughout the UK with an investment focus on traditional industries where pioneering companies are able to adopt innovative technology to improve products and services.
Midlands Enterprise Capital Fund	£30 million generalist fund, which includes £18 million of government funding, will focus on investments in the Midlands region, but will consider UK wide opportunities. This is the only fund to come out of the initial pathfinder bidding round that has significant backing from institutional investors, in this case Local Authority pension funds. Catapult Venture Managers will manage the Fund.

Source: www.sbs.gov.uk

ultimate sale, where the Corporation could contribute its considerable expertise in the sale of unquoted businesses (especially in the tax-efficient structuring of such transactions).

2.16 ICFC's, and later 3i's, success lay in employing investment structures that: produced a strong preferential yield (interest and fixed dividends), the earliest possible repayment of the vast bulk of the capital (repayment of loan and redemption of preference shares) and still left it with a worthwhile shareholding in case the business floated or was sold – and with the minimum of oversight or intervention by the investor. All this was achieved through a complex set of share rights and a subscription agreement which left the management with precious little control over the uses to which they could put any profits not earmarked for an ICFC dividend.

– co-ordinating the delivery of public services to SMEs.

117 Extracted from SBS website: <http://www.sbs.gov.uk>

118 Macmillan Committee (1931).

119 Coopey and Clarke (1995) p38.

2.17 At its zenith in 1988, 3i had a portfolio of 4,789 investments with an aggregate value of £1.6bn and accounted for over 38.5% of investments made by BVCA members (in the year measured by value, a figure only exceeded in 1990 when 3i accounted for 50.1% of BVCA members' investment activity). At that time it had a network of 23 regional offices and employed nearly 800 staff. Its influence was felt throughout the industry, not least in the behaviour of its competitors, because it had trained and 'blooded' many of the investment managers who ran those competitors. At the time, it would have been true to say 3i's culture was a highly financially oriented one – its investment executives were, to a large extent, generalists, selected either as graduates or as relatively newly-qualified accountants and other professionals. Indeed, industry knowledge and expertise was concentrated in the 'Industry Department', which comprised of a panel of experts who reviewed investment proposals put up by the investment executives in the regional offices.

2.18 3i has changed from what it was in the 1980s and is now organised into three divisions concentrating on buy-outs, development capital and venture capital. While the buy-out and development capital divisions remain financially oriented, the venture capital division is organised, and operates, much more along the lines of a US venture capital firm.

2.19 However, while it is true that 3i today has a more diverse investment approach, it is reasonable to conclude that its traditional finance-centred approach to investment, combined with its ubiquitous influence on the industry, may well be a significant factor in why the UK venture capital industry has been so much more successful in managing and developing private equity funds than venture funds.

2.20 Although there had been a handful of specialist UK venture capital firms such as Advent¹²⁰, in IT and telecoms, and Abingworth¹²¹, in life sciences, founded during the 1980s, frustration with the finance-centred approach of the UK industry during the 1990s led a number of different groups and individuals to set up or develop funds consciously modelled on the best US West Coast funds. Hermann Hauser, the co-founder of Acorn computers (whence ARM, the global semiconductor IP business, span-out), joined forces with an experienced venture capital team to form Amadeus Capital Partners¹²² in 1997. Pond Ventures was formed in the same year by the Irving brothers and others.

2.21 So far, however, none of these investors have matched the track-record of the established US funds, such

as Accel¹²³, Kleiner Perkins¹²⁴, Mayfield¹²⁵, Menlo Ventures¹²⁶, Oak¹²⁷ or Sequoia¹²⁸. One reason for this is the shortage of management talent in the UK.

Management, Venture Capital and Business Angels

2.22 One of the characteristics of the UK economy, described in Chapter 1, is its relatively small number of large, technology-based businesses outside pharmaceuticals, defence and aerospace. This limits the size of the available pool of management talent, especially that which is experienced in the product-to-market process, for smaller, technology-based businesses.

2.23 This has an impact on the development of science- and technology-based growth businesses, in several ways. Apart from management issues, it means that these businesses do not have easy, local access to large companies that could be their natural customers, suppliers and partners.

2.24 However, apropos management, it means that these growth businesses do not have access to ambitious, well-trained middle managers with relevant large company experience who could be motivated by the opportunity of a key role in a business offering managerial challenge as well as the prospect of personal wealth.

2.25 In contrast, taking the Palo Alto municipality in the San Francisco Bay area as an example, a science-based business spinning out of Stanford University is cheek-by-jowl with Hewlett Packard, Intel, Apple and Sun – with all the opportunities that such proximity brings. These large companies employ thousands of middle managers, many with product-to-market experience. The founders—academic or commercial researchers—of a science- or technology-based business may well live next door to, or otherwise come routinely into contact with, people with the skills to develop the business commercially.

2.26 Few places in the UK, or Europe or even Israel, offer the advantages that Silicon Valley, Seattle or greater Boston offer. This puts a greater burden on investors in the UK and Europe to meet the challenge of finding and retaining excellent management.

2.27 The example of Israel is stark¹²⁹. The Israeli venture capital community has been highly successful in

120 <http://www.adventventures.com>

121 <http://www.abingworth.com>

122 <http://www.amadeuscapital.com>

123 <http://www.accel.com>

124 <http://www.kpcb.com>

125 <http://www.mayfield.com>

126 <http://www.menloventures.com>

127 <http://www.oakinv.com>

128 <http://www.sequoiacap.com>

129 See, for example, Gill et al. (2002).

nurturing the local management of Israeli businesses through start-up and early commercialisation phases but, for many of its most successful businesses (such as Checkpoint, InterPharm or Scitex) this has been followed by relocation of the principal commercial activity of the business, including its domicile, to the US. Once there, the company benefits from having both the financial resources of the US venture capital industry and a vast pool of management talent available to it.

- 2.28 Encouragingly, a similar though modest, tendency is starting to be perceptible in the technology cluster around Cambridge. During the 1970s and 1980s, successful local technology businesses, such as Applied Research Cambridge, Cambridge Interactive Systems and Acorn, had ended up being sold to overseas acquirers. In contrast, the crop of businesses founded there during the 1990s look much more like Israeli businesses—research functions continuing in Cambridge, but with commercial activity based in the US offices. Ownership is more diverse with, for example, Virata merging with the US company Globespan to form a true multinational (since acquired by Conexant), but ARM, Cambridge Silicon Radio and Autonomy remaining LSE quoted companies.
- 2.29 Moreover, a number of UK or European venture capital firms, such as Pond Ventures, Index Ventures and Thompson Clive, have offices in the US and are consciously emulating the Israeli business development model.
- 2.30 A valuable corollary of this development is that Cambridge, like Tel Aviv or Bangalore, is gaining and retaining management talent that it previously did not have. Entrepreneurs and CEOs of successful Cambridge businesses are deciding to remain in the region to found new businesses or to be the investors in, and mentors of, a new crop of technology start-ups. They have strong relationships with the venture capital investors who backed their businesses and, when acting as business angels, have the reputation and relationships to attract first-tier, international venture capital firms. An example of this is the investment by Accel, Amadeus, Index and Oak in Artimi—a fabless semiconductor company founded by an ex-Virata team and initially backed by Cambridge Angels, a local angel syndicate that includes the former CEO of Virata.

Business Angels

- 2.31 The UK has always had high levels of private investor activity in growth businesses. Charterhouse, which created a niche for itself between the wars as promoter of smaller growth businesses raising public capital (and, by implication, operating just above the equity gap identified by the Macmillan Committee), raised most of that money from private investors rather than institutions.

2.32 After the war, a combination of high personal taxation and state intervention discouraged private investor participation in the financing of growth businesses; and it was largely confined to the informal processes of ‘family and friends’ investment.

2.33 During the 1980s, the Conservative Government, with a popular capitalist agenda, started to look at means to encourage greater private investment in growth businesses. The Business Start-up Scheme (BSS), later renamed the Business Expansion Scheme (BES), was set up in 1982 and offered attractive personal tax relief for investment in start-up (initially) and early-stage (subsequently) businesses. This scheme, refined and renamed the Enterprise Investment Scheme in 1994, continues to operate today.

2.34 By the mid-1990s, research by Colin Mason of Southampton University¹³⁰ and Richard Harrison of the University of Ulster, suggested that there were about “18,000 active business angels in the UK” and that “Investments by business angels comprise about £500 million in 3,500 businesses each year.” Moreover, Harrison and Mason went on to estimate that the number of investment transactions in early-stage businesses by angels was ten times that by venture capital investors with four times the total capital committed.

2.35 This data is hard to verify, but it is clear that business angel activity in the UK has increased significantly in the last fifteen years. Investment under the Enterprise Investment Scheme (EIS), for example, increased from £53m in 1995–96 to over £1bn in 2000–01,¹³¹ although activity has subsequently declined.

2.36 Government activity to promote business angel investment has been consistent through all administrations since the 1980s. This has included tax breaks for individual investment in growth businesses (BSS, BES and EIS described above) and relief for investment in collective venture capital schemes through Venture Capital Trusts. See Table 2.3 for comparison.

2.37 The government, especially since the current Labour administration was elected in 1997, has also directed funding at promoting regional networks of business angels, usually under the auspices of the network of Regional Development Agencies in England and their equivalents in Scotland and Wales. It has also invested in a series of smaller funds, under an initiative called Early Growth Funding, set up to co-invest with business angels.

2.38 It is important to emphasise that business angel activity in the UK has also developed in ways not involving the government. In several of the technology clusters across Britain, experienced investors and

¹³⁰ Mason and Harrison (1997).

¹³¹ HM Treasury (2003).

entrepreneurs have banded together in syndicates which operate on a collective basis. Examples include Cambridge Angels, Cambridge Capital Group (both in Cambridge), e-Synergy (in London), Braveheart and Archangel (both in Scotland). Each has its own way of operating, some with more formal central co-ordination, others as a loose federation of investors.

2.39 Cambridge Angels, for example, has had a significant number of successful technology entrepreneurs among its members, including the late Stephen Thomas, co-founder of Geneva Technology, the billing systems company acquired by Convergys in 2001; Hermann Hauser (mentioned earlier); and Robert Sansom, co-founder of FORE Systems, the ATM networking technology business acquired by Marconi. This body of experience among the 25 members of the syndicate, which is reflected in the membership of the other syndicates, is much more characteristic of US early-stage investors, both angel and venture capital, than it is of UK venture investors.

2.40 It may be that the most effective UK seed investors are the business angel syndicates made up of successful technology entrepreneurs or former chief executives. That said, there is some truth in an observation by Danny Rimer, general partner at Index Ventures¹³², that general management and investor skills do not always co-exist happily in the same individual.

Nonetheless, an investor who understands business development, especially the product-to-market process, is much more likely to add value to an investee firm, not least through personal contacts, than one who does not.

2.41 While business angels are a source of deal-flow for venture capital funds, there has been little effort to formalise this process. Many angels perceive venture capital investors as arrogant and commercially naïve, and there is considerable resentment about the terms on which venture capital firms invest in previously angel-backed businesses. The suspension of pre-emption rights and the imposition of redemption premiums by the venture capitalists are seen as particular irritants. This may be a factor in why many angel-backed companies look to an early IPO on AIM (see figure 2-2) as a source of growth funding.

Stock Markets

2.42 The UK is unique in Europe in the size and liquidity of its stock markets. Trading volumes and the aggregate capitalisation of the companies listed on the London Stock Exchange (LSE) are third only to those on the New York and Tokyo Stock Exchanges.

Table 2.3: Comparison of EIS and VCT Features

	Enterprise Investment Scheme (EIS)	Venture Capital Trusts (VCT)
Summary of schemes	• Individual investors subscribe directly for shares in an EIS eligible company	• Individual investors subscribe for shares in a VCT - a quoted, professionally-managed company which invests in qualifying companies
Tax reliefs	• 30% 'front-end' income tax relief on investments in EIS shares	• 30% 'front-end' income tax relief on investments in VCT shares
	• Exemption from capital gains tax (CGT) on disposal of EIS shares	• Exemption from capital gains tax (CGT) on disposal of VCT shares
	• Unlimited CGT deferral where chargeable gains on other assets are invested in EIS companies	
	• Income tax relief on most losses on EIS shares	• VCT dividend payments exempt from income tax
	• Shares must generally be held for at least 3 years for EIS income tax relief to be retained	
Limits and restrictions	• EIS income tax relief limited to investments of up to £400,000 per tax year	• Shares must be held for at least 5 years for VCT income tax relief to be retained
	• The investee company's gross assets must be no more than £7m before the investment, and no more than £8m afterwards	• All VCT reliefs limited to investments of up to £200,000 per tax year
	• Funds must be employed by the investee company within 12 months	• The investee company's gross assets must be no more than £7m before the investment, and no more than £8m afterwards
		• 70% of investments by the VCT must be in newly-issued securities in eligible companies
		• a VCT may invest no more than £1m per year in any company
	• Companies issuing shares to a VCT must be unlisted (companies quoted on AIM and OFEX are eligible)	
	• The VCT may not hold more than 15% of its investments in any single company	
Full details of the schemes may be found at www.hmrc.gov.uk .	Investee companies must also satisfy certain qualifying conditions throughout a three-year period in order for most EIS and VCT reliefs to be retained.	

¹³² <http://www.indexventures.com>

2.43 The UK's secondary market, called the Alternative Investment Market (AIM) which was founded in 1995, has proved a remarkable success, with 32 IPOs in April 2005 alone (17 in April 2004) and an aggregate capitalisation of £35.7bn. AIM was launched after the previous secondary market, the Unlisted Securities Market (USM), had become moribund—principally because the differential in compliance requirements between it and the LSE had been eroded as the LSE reacted to competitive pressure following de-regulation (Big Bang) in 1986.

2.44 Figure 2-2 shows the remarkable growth in the aggregate capitalisation of AIM from its foundation in June 1995, when ten companies were listed with a capitalisation of £82.2m until April 2005 when 1166 companies were listed with a capitalisation of £35.7bn. Even the collapse in world share prices in 2000–2001 had a limited effect on AIM, which had 524 companies with a combined capitalisation of £14.9bn at the end of 2000 and 629 companies with a combined capitalisation of £11.6bn at the end of 2001. More than 2,200 companies have been admitted and more than £24 billion has been raised since AIM began in 1995¹³³.

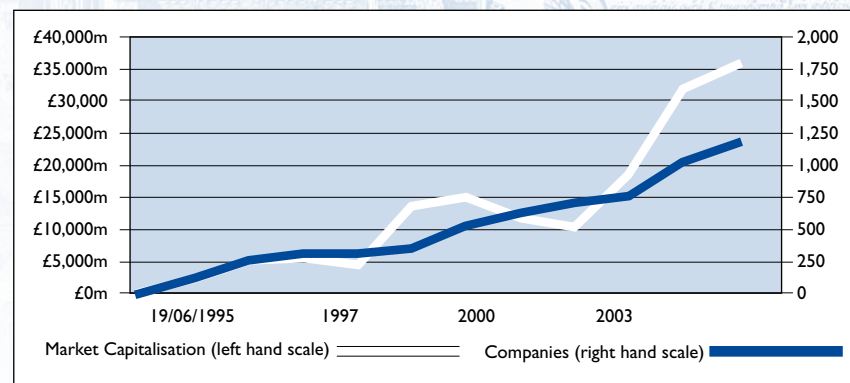
2.45 The number of technology-based growth businesses listing on AIM has accelerated since the flotation of Wolfson Microelectronics in October 2003 and they form a significant proportion of its market entrants, including companies such as Bango, the Cambridge-based mobile data and content services provider (IPO in June 2005).

2.46 One of the principal drivers of the success of AIM is its benign tax status for individual investors. Many of the tax incentives available for investment in unquoted companies, such as the Enterprise Investment Scheme and Venture Capital Trusts (see Table 2.3), are preserved following flotation on AIM and for new investment into those companies¹³⁴. This makes it an effective alternative to venture capital for fund-raising by companies initially backed by business angels and looking for follow-on capital in the £2–10m range.

2.47 Moreover, the commonly-held perception of AIM as an illiquid market for small companies is proving increasingly unfounded. Nearly 20% of the companies listed on the market have a capitalisation greater than £50m and the more actively-traded companies can turn over half their market capitalisation in a month. The opportunity for further fund-raising after IPO is considerable, with 45% of the capital raised by AIM companies since the market's inception coming from further issues¹³⁵.

2.48 AIM's growth has also been fuelled in part by the US

Figure 2-2: AIM – Companies Listed and Market Capitalisation 1995–2005



Source: London Stock Exchange – www.londonstockexchange.com

Sarbanes-Oxley Act of 2002, one result of which has been a noted driving of IPOs away from NASDAQ to London¹³⁶.

“Today, AIM is successfully persuading small U.S. companies to take their stocks public in the United Kingdom. In 2005, 19 U.S. companies raised \$2.126 million worth of IPO capital through AIM in London. This year, AIM will hold seminars on the U.S. East Coast, West Coast, and in the Midwest for American companies looking for alternatives to the costs associated with a U.S. based IPO. AIM, which touts itself as the “world’s most successful market for smaller, growing companies,” is also working with U.S. venture capitalists and directly contacting small companies that are considering going public to inform them about the benefits of floating an IPO in London instead of in the U.S.”¹³⁷

Summary and Conclusion

2.49 Whilst the UK venture capital industry is significantly more developed than that in the rest of Europe, it remains weighted towards private equity rather than venture capital.

2.50 The reasons for this are varied but among them are: the traditional finance orientation of the UK venture capital industry; a shortage of skilled managers, especially with product-to-market skills, both in the venture capital industry and in technology-based firms; and a dearth of successful large technology businesses in the UK.

¹³⁶ “I am acutely aware and disturbed by the fact that initial public offerings have moved away from the US — and to a large extent have moved to London”, Alan Greenspan, former chairman of the US Federal Reserve as quoted at www.timesonline.co.uk on 13th April 2006.

¹³⁷ From a letter from U.S. Senator Olympia J. Snowe Chair, US Senate Committee on Small Business and Entrepreneurship to Securities and Exchange Commission Chairman Christopher Cox - <http://sbc.senate.gov/HTML/news/US-BasedIPO-Overseas.html>

¹³³ <http://www.londonstockexchange.com/en-gb/products/companyservices/ourmarkets/aim/> accessed 18 June 2006

¹³⁴ SJ Berwin - <http://www.sjberwin.com/>

¹³⁵ SJ Berwin - <http://www.sjberwin.com/>

- 2.51 Since 1997, the UK Government has been proactive in addressing what it sees as a structural failure to provide finance for smaller, growth businesses. It has committed public money to regional venture capital funds, targeting SMEs, and to funds focused on businesses emanating from the UK scientific and university research base. The UK Treasury has created Enterprise Capital Funds to emulate the example of the US SBIC initiative.
- 2.52 There is some evidence that venture capital investors in the UK are starting to use a similar investment and business development model to that used by venture investors in Israel—migrating the centre of commercial activities of their investee companies to the US while maintaining R&D activities in the UK.
- 2.53 Business angel activity in the UK has risen steadily since the 1980s when the first government tax incentives for investment in SMEs were introduced. The ability of business angels to preserve their tax incentives after an investee IPOs on AIM has further reinforced the development the UK's business angel community as well as contributed to the success of AIM as a growth company market. Business angel activity has become the most significant source of seed investment into UK growth businesses, both technology and non-technology based.
- 2.54 Business angels are a broad church from the passive to the highly active and from the interfering but ineffective to the significantly value-adding. It seems that successful UK technology entrepreneurs are often becoming business angels and contributing their experience, as well as money, to early-stage growth businesses through formalised syndicates, usually based in the established technology clusters.
- 2.55 The UK growth company market, AIM, has grown strongly since its inception in 1995 and there is some evidence that a combination of business angel investment and an early flotation on AIM is becoming an alternative to venture capital funding for UK science- and technology-based growth businesses to a certain degree. However, volumes need to grow much more before this becomes a convincing alternative, for example, to NASDAQ in its heyday.

Banks and Financial Services

“Among other things, we had to compile a monthly return of messing by-products, to show how much we had saved for the war effort. Late one night, having completed this vital document, I found that I had added pounds avoirdupois of dripping to cubic centimetres of tea-leaves. I was too bored to change it and shortly afterwards we received a special commendation from GOC London District for a remarkable achievement in effecting savings.”

John Barnes¹³⁸

“Bankers: All rich. Sharks and swindlers.”

Gustave Flaubert¹³⁹

Introduction

- 3.1 Banks and early-stage technology firms have an uneasy relationship. On the one hand, for most small firms, a bank is one of the main sources of informal guidance, and small firms identify banks as a likely source of funds. On the other, technology firms in particular consistently reveal characteristics that make them at best difficult candidates for bank funding. In general, the major UK banks have been neither consistent nor skilled in providing services to the technology sector.
- 3.2 Some of the funding gaps, both before and after private sector investors become involved with technology firms, are filled by grants. The grants regime has recently been overhauled and most practitioners consider it to work reasonably fairly and efficiently.
- 3.4 Put at its simplest, the quandary for a mainstream commercial bank is that it can offer its small business customers two main types of services: lending and non-lending. With established businesses, where the risk factors can readily be identified and quantified, lending is likely to be a profitable activity. But banks tend to consider early-stage technology firms poor lending opportunities, preferring to offer much lower-risk services such as money transmission, key man or patent insurance. This reluctance to lend can in turn be ascribed to two main factors: understanding and reward. The issue of reward is fairly straightforward (see box study: Why Banks Don't Lend to Technology Firms). The breakdown in understanding between banks and technology firms requires a little more explanation.

Trouble at Banks

- 3.3 Criticism of banks in the context of support for technology firms is not new. In a revealing collection of papers presented to an Institute of Bankers seminar held in Cambridge in as early as 1984, Lord Boardman, the then chairman of the National Westminster Bank plc, said:

*“We should not be surprised as bankers to find ourselves under the spotlight at this time of national economic recovery and at the dawn of a new industrial revolution. But it is unrealistic for Government and industry to assume that the banks alone can provide the entire financial support needed to bring forward a golden age. Some argue that we should.”*¹⁴⁰

The Empathy Gap

- 3.5 That banks may find understanding proposals from technology firms difficult is not surprising. If the proposal is genuinely ground-breaking, it is likely to present risks at three levels: the technology itself (does it work? how well?); the scope of the market (how to identify comparators for a disruptive innovation); and the management team, which at the stage when it first approaches a bank is likely to be incomplete and may well be dominated by researchers rather than commercially-experienced entrepreneurs. The individual risks can be broken down and analysed separately (as set out, for instance in the box study HSBC Technology Appraisal Scheme and in Annex C). But a mismatch of expectations as between

¹³⁸ Barnes (1992).

¹³⁹ Flaubert (1850) (“BANQUIERS: Tous riches. Arabes. Loups-cerviers”).

¹⁴⁰ Institute of Bankers (1984) p70.

Venture Lending

In undertaking the research for *Funding Technology: Lessons from America*^I in late 1999, we interviewed several US practitioners of a type of funding not then found in the UK: venture lending. Venture lending was popular in the US at that time (a majority of companies in receipt of venture capital probably received venture lending as well) and remains so today, despite a reduction in the number of providers. Such lending reduces the dilution of founders' equity inherent in venture capital investment.

In the years since *Lessons from America* was published, several US-owned (or inspired) operators have set up in the UK, but venture lending remains a minority pursuit. Strictly speaking, *venture lending* covers two different types of loan finance:

- *Venture leasing*, which enables an early-stage company to lease equipment such as computer hardware from a specialist lender without using additional equity finance, which would further dilute the founders. In addition to conventional leasing terms (interest and monthly repayments staged over three to four years), the lender will take an equity 'kicker' or share warrant to be exercised in the event of an IPO or other significant liquidity event. Specialist venture leasing firms can bridge the gap left by mainstream financial institutions.
- *Venture loans*, which developed out of venture leasing to sectors with fewer equipment needs, provide generic loan finance rather than specific asset finance and therefore tend to be more suitable to complement later rounds of equity funding. Venture loans are likely to be for short periods, looking to the next funding round in two to four years. An equity kicker would again be a standard term; other terms, such as an initial capital repayment holiday, are negotiable depending on the calibre of the borrowing company.

Venture lending is popular in the US because it enables equity investment to be stretched further. Debt and equity providers thus depend heavily on each other; without an active venture capital market, the opportunities for venture debt are limited. Venture lenders tend to rely on the due diligence conducted by the equity investors; high levels of trust as well as complementarity are therefore required. The calibre of the investor is paramount for debt providers.

However, the risk/reward parameters differ between the two types of funding: an equity fund only expects to have two or three 'winners' in its portfolio and accepts a failure rate of perhaps 30% to 40%; since a venture lender relies on a small equity warrant (perhaps 7% coverage) for its upside, it cannot afford more than occasional losses. Venture lenders therefore have a risk profile close to that of conventional banks, but produce higher returns through judicious exercise of equity kickers to justify their additional leverage.

The advantages of venture debt include not only limited dilution but also relative speed in closing a funding round (if a lender will 'tag along' with an investor) and the opportunity to defer some costs (such as legal costs) until the warrants are exercised, at which point the investee company can expect to be more

liquid. But as with every form of debt, the risk to the company increases as regular repayments are required, even with flexible terms such as delaying capital repayments for a year. As noted in *Funding Technology: Israel and the Virtues of Necessity* (p27), venture lenders in the US did overreach themselves at the end of the dot.com boom, with one major provider (Comdisco^{II}) going into receivership.

Since *Lessons from America* was researched, several venture lenders have been established in the UK. The US associations of the industry are still apparent, though: not only has Silicon Valley Bank^{III} set up a London office, but one of the leading European players—ETV Capital^{IV}—grew out of a joint venture with GATX^V, the leasing provider based in Chicago (ETV is now independent). A limited number of 'indigenous' funds have also been established (Noble Fund Management^{VI}, European Venture Partners^{VII}) but UK-based providers invariably look across Europe (and Israel^{VIII}) for deal-flow.

This is hardly surprising: since venture debt relies on the scale and sophistication of the equity venture capital market to thrive, the limitations of UK VC once again come into play as much as do the opportunities. Moreover, no mainstream UK bank is equipped with appropriate knowledge and understanding of the tech-investment sectors to tackle venture lending.

I Gill, *et al.* (2000)

II "Comdisco emerged from chapter 11 bankruptcy proceedings on August 12, 2002. The purpose of reorganized Comdisco is to sell, collect or otherwise reduce to money in an orderly manner the remaining assets of the corporation." www.comdisco.com/press_release.asp?pressreleaseid=192

III <http://www.svb.com/services/globalnetwork.asp?uk>

IV <http://www.etvcapital.com/>

V <http://www.gatx.com/index.asp>

VI <http://www.noblegp.com/nfm/npe>

VII <http://www.evp.co.uk/>

VIII See also http://www.plenus.co.il/app/venture_lending.asp

banks and technology firms—often referred to as ‘the empathy gap’—has proved a persistent barrier to greater engagement in the tech sector on the part of banks.

3.6 The empathy gap was first identified and catalogued by Duncan Matthews OBE, head of the innovation and growth unit at NatWest in the 1990s. Table 3.1 summarises the main characteristics of the divide between what banks on the one hand look for when evaluating small firms as lending customers and on the other hand the likely features of small technology firms. Banks like stability, predictability and fall-back forms of repayment, such as tangible assets; technology firms exhibit unpredictable growth patterns and rarely have more tangible than intangible assets. The term ‘empathy gap’, mirroring the long-recognised ‘equity gap’, has become sufficiently well-accepted to be cited in Parliamentary debates:

“We are now seeing the creation of technology angels, too. It is important to breach the empathy gap and ensure that everybody understands the new technology. [Interruption.] I see that the term “empathy gap” has provoked some discussion on the Opposition Benches. That phrase was first coined by Duncan Matthews, the head of the National Westminster bank’s innovation unit. What he meant by it was that the new technology may not always be understood by the financial institutions. That is why it is so important for there to be, as increasingly there is, a good relationship between the financial institutions, the academic world and business. The Government are committed to fostering that partnership approach.”¹⁴¹

3.7 Can the empathy gap be bridged? As Lord Boardman himself put it 20 years ago: “But financing new technology presents a particular challenge to the banks which is being met in a variety of ways.”¹⁴² He went to identify nine areas in which progress was required. It is instructive to consider how relevant his analysis remains and how much progress has been made in the intervening period:

1. “Co-operation between government, industry and the financial community”
2. “The major financial problem facing many small firms is insufficient equity”¹⁴³
3. “Bankers must be prepared to look as much to the future cash flow and maturity of the new technology company as to security and gearing considerations”
4. “[...] small businesses must make use of technical

Table 3.1: Empathy gap

Banks have been used to:	Technology firms have:
Steady growth forecasts	High growth rate, but often initial trading loss
Stable cash flow forecasts	Fluctuating cash needs
Track records	Business inexperience
Documented market	New market / technology
Strong balance sheet	Intangible balance sheet

Source: Table first devised by Duncan Matthews OBE, former Head of Innovation & Growth Unit, National Westminster Bank plc

- consultants, not only to appraise the technical merits of their product but also its commercial potential”
5. “More research needs to be done into the problems and needs of small businesses generally.”
 6. “Further training is required to enable bankers to understand technology and the changing needs of the businesses involved with it”
 7. “[...] encourage the banks to train junior management staff as specialists in the small corporate sector assisted by industry specialists”
 8. “Special funds have been set up to invest in the small company sector and in new technology for several years. But the amounts involved are still modest when matched against investment in other sectors and against the demand for funds by the small business community.”
 9. Competition has “encouraged the banks to look upon the small business sector as a profitable market in its own right within which high technology companies offer excellent prospects for growth and a long-lasting relationship with a bank”¹⁴⁴
- 3.8 Progress has been made over the past 20 years on several of the factors identified. Particularly since the low point in relations between banks and small firms in general reached during the 1990–92 recession, dialogue has improved steadily; some of the credit for this improvement is due to the Bank of England’s regular annual review of the financing of small firms. Such annual reviews have also included specialist topics, notably for present purposes, two reports on the financing of technology-based businesses (1996, 2001). It is regrettable that the April 2004 survey of these firms was the last to be conducted by the Bank. The small firms sector has become the object of considerable research—academic and commercial. But the funds earmarked for investment in new technology remain modest. And the banks themselves have not adapted in the intervening period as Lord Boardman envisaged.

141 Barbara Roche MP, then Minister for Small Firms, House of Commons, 7 November 1997 (cited in Hansard, column 489)
 142 Institute of Bankers (1984) p66.
 143 Lord Boardman unfortunately gave currency to a persistent myth of the 1980s: “The skill and experience of the clearing banker in Britain, unlike West Germany for example, does not extend to taking sizeable equity stakes in industry.” lb p73. For further consideration of the point, see Gill, et al. (2003) p28.

Specialist Help for Technology

3.9 Several of the 1984 Boardman recommendations envisage a role for specialist teams in the joint stock banks to tackle technology markets: cash flow lending;

144 Institute of Bankers (1984) pp73-75.

Why Banks Don't Lend to Technology Firms

Debt providers obtain their reward from the margin of interest over the cost of providing funds. Suppose that a bank lends to a small company at a margin of 2%^I. Suppose further that the bank has a cost/income ratio of 50%: it employs people and installs software systems to assess the risk, approve and manage the loan. This means that its net income before tax is likely to be only about 1% of its loan book.

Even if the bank generated additional lending income—by taking a 1% arrangement fee, say—it would start to lose money if more than about 1.5% of its lending went bad. Most established banks have provisions of 0.5% or lower for bad and doubtful debts. The margins for error are small. One additional company defaulting in a portfolio of 100 customers may only represent 1% of funds advanced, but if none of the loan is recovered, the bad debt rate will treble (from an average of 0.5% to 1.5%) and its net margin after costs will reduce to barely economic levels, depending on when in the life of the loan the default occurs (if the default occurs in year 1, the bank will only receive £200,000 interest; later defaults allow for further interim payments).

Loan per customer:	£100,000
Number of customers:	100
Total portfolio value:	£10,000,000
Arrangement fees 1%:	£100,000
Annual margin income 2%:	£200,000
Total lending income:	£300,000

Net income @ 50% cost income ratio £150,000
= one-and-a half customer loans before bad debts

Does this matter? For many years British banks were urged to be more like their German counterparts by acting as funding partners for industry. However, more recently the weakness of the German banking sector has led to a wider appreciation of the need for 'strong' rather than 'generous' banks: "In my view, the biggest contribution Deutsche can make to Germany is to be as big and as profitable as possible. In the end only a strong bank can be a reliable partner for business." ^{II} And bank profitability has wider economic implications for the UK: "In

I "Data supplied to the Bank by the main banks suggest that the average margin over base fell during 2003 to around 2% at the end of the year." Bank of England (2004), p11.

II Josef Ackermann, Chief Executive of Deutsche Bank; cited in Gill *et al.* (2003) p26.

technical consultants; training junior management staff as specialists, assisted by industry practitioners. The irony is that over the past 25 years, each of the major clearers has gone down the specialist path, but not for long enough—or in sufficient numbers—for theseparate initiatives by the individual banks to have had a material impact on the technology sector in the UK.

just six months UK banks paid enough in taxes to cover a third of the Government's Transport Bill, or the annual budgets of the Department for Environment Food and Rural Affairs or the Department for Constitutional Affairs." ^{III}

But are technology firms really more risky than other small companies? Or is it just that the banks believe that tech firms are riskier and so do not proceed with appraising lending propositions in the tech sector? What little evidence there is suggests that tech firms may indeed be a better credit risk than average ^{IV}; much more empirical research is required on this issue for the UK to build up its innovation sector. As one experienced manager put it to us: "Even the toughest lenders want to hide under the desk when a proposal comes in that involves coloured wires or Petri dishes; they're glad if they can turn it down because of high gearing."

It also appears that banks without specialist appraisal procedures confuse uncertainties (how well the technology works, size of the market, quality of management team) with risk. Generalised uncertainties could be converted into specific quantifiable risk through long-range empirical mapping of the behaviour of technology customers. But no UK bank has yet stayed in the tech sector long enough to establish suitable risk assessment tools as part of standard credit systems.

III *The Times*, London, 7 August 2004, p48.

IV "Over the eleven years, more than three-quarters of German and UK firms have continued to survive. This is a substantial and encouraging statistic and confounds popular opinion of the vulnerability of high tech young firms. Innovative firm are more likely to survive than the generality of new firms in a rapidly changing environment. They invest regularly but do not expend excessive amounts on R&D or in recruiting scientists and engineers. We also know that continued scarcity of general management and, particularly, financial management resources observed early in the firm's life cycle are strongly linked with subsequent non-survival. Similarly, relying on core products/ services that embody little innovation also threatens survival." Cowling *et al.* (2005) p2.

3.10 Lord Boardman expressed concern that cooperation would "dilute the benefits of a healthy competition between the banks that serves as a catalyst for ever higher standards of service"¹⁴⁵. In fact, the behaviour of the commercial banks over the past quarter of a century has resembled an informal relay rather than a competitive race. At any given period since the late 1970s, only one bank at any given time has put

145 *Ibid.* p75.

resources into the early-stage technology sector:

- In the late 1970s into the early 1980s, Barclays was the lead bank for technology firms, mainly on account of its experienced gained around Cambridge. Much of Barclays' achievement was not down to corporate policy but to the initiative of two or three key individuals. As they moved on, Barclays lost momentum.
- Up to the late 1990s, the leading bank in the sector was NatWest. The innovation and technology team (whose work has already been referred to) pioneered useful conceptual tools in understanding the technology market, as well as technology and market information services for lending managers, and an appraisal scheme (New Technologies Appraisal Service—NTAS) designed to assess “the commercial viability, technical feasibility and the future potential of the enterprise”.¹⁴⁶
- For some six years from 1998, HSBC dedicated resources to the sector, developing a strong reputation among early-stage technology firms and their advisers. HSBC established two professorial chairs of innovation (one at Brunel University, the second at the University of York) and a national network of technology banking managers in research-intensive locations. The appraisal methodology developed with the universities is set out later in this chapter in a box study. In mid-2004, HSBC disbanded its innovation and technology unit.
- More recently LloydsTSB started to ‘clone’ its successful Cambridge-based technology team in other promising locations across the UK, such as Edinburgh. The bank has conservative lending criteria, refusing on principle to use the small firms loan guarantee (SFLG) scheme for young technology firms on the grounds that all such firms require risk capital or equity rather than debt with a guaranteed element. It does, however, have access to captive venture capital funds. Lloyds TSB started to play down its presence in the technology market in 2005.

3.11 Given the consistency of the pattern of serial rather than contemporaneous or competitive involvement in the technology market on the part of the four major UK clearing banks (who between them control 86% of the small- and medium-sized enterprise market)¹⁴⁷ some explanation is called for. After all, since competition is fiercest when only a small number of players is involved, it is probable that if several major banks were to become involved in the innovation market simultaneously, the market as a whole would grow as each bank sought dominant status. Although no one explanation is sufficient to cover the behaviour of all banks in the sector since the late 1970s, some patterns do emerge:

- Innovation teams are likely to be run by enthusiasts difficult to replace in the ordinary course of career

Barclays Bank in Cambridge through the 1970s and 1980s

In 1978, Matthew Bullock (the assistant manager at the Bene't Street branch of Barclays) identified the potential importance of the business spinning out of the University and from knowledge-based enterprises in the Cambridge area. He persuaded Edmond Parker, the senior local director of the bank in Cambridge, to adopt a more proactive approach to these businesses and Walter Herriot (a business advisory services manager) was appointed to devise the bank policy and put it in to practice.

In conjunction with Jack Lang, a local entrepreneur with a Cambridge University background, the Cambridge Computer Group was established to provide a focus and to encourage self help. Herriot worked with members of the group to provide advice on business issues and also assisted in writing business plans to raise finance.

The bank, being in receipt of better quality plans, was able to assist more proposals for businesses particularly amongst high-tech start-ups with no track record.

Starting with 20 companies in 1978 the number of companies in the Cambridge cluster grew to over 360 by 1985. The bank's failure rate in the high-tech sector in this period was lower than it was for normal businesses in the sub-region. Following the production of the Segal Quince Wicksteed report—The Cambridge Phenomenon—the bank decided that their policy had been successful and they would leave it to others to ‘take forward’.

progression (and acting as an innovation manager does not represent a mainstream banking career choice).

- Banks need to invest heavily in the early years in management training and specialised marketing; the pay-off for such investment, whilst potentially significant over the long term, is likely to fall outside the one-to-three year planning cycle common in the industry.
- Such investment is easy to cut by new senior management looking for short-term cost reductions.

3.12 However, the most likely explanation for the lack of a consistent presence of the individual clearing banks in the innovation market is their inability to develop products to enable them to share in the market's upside. Despite sporadic attempts over the years (such as NatWest's promotion of ‘Growth Options’ in the early 1990s) no major bank has successfully marketed financial products akin to the ‘venture lending’ and ‘venture leasing’ used extensively by specialist banks in the US¹⁴⁸. Although a UK clearing bank active in the technology sector may be reasonably well-rewarded over time by recruiting a portfolio of firms with lower failure rates, a propensity to grow faster than the SME average and to buy more products, the additional marginal income will probably only cover the higher recruitment costs (such as running an appraisal scheme) unless the bank can take an equity kicker or invest in venture capital.

3.13 Banks should not, as lenders, be providers of risk-finance more appropriately sourced from professional investors able to balance losses against gains on a portfolio basis. However, in consistently reducing or omitting resources aimed at the technology sector

¹⁴⁶ Bishop and Matthews (1996), p16.

¹⁴⁷ Bank of England (2002), p15.

¹⁴⁸ Gill et al. 2000 pp13, 33.

Cambridge Silicon Radio plc

Cambridge Silicon Radio (CSR) was founded in 1998 by a team of nine engineering employees from Cambridge Consultants Limited (CCL) in Cambridge, UK. Over the years, CCL has developed many technologies which have grown into businesses in their own right. The revenue generated from these spin-outs not only added to the bottom-line, but provided the company a mechanism of defence against cyclical downturns in the consultancy industry.

One of the most celebrated spin-outs from CCL remains CSR—a company focused on the single-chip short-range radio market. The consultancy spun-out CSR with \$10m backing from 3i, Amadeus Capital Partners and Gilde IT Fund. CCL retained a shareholding in the new venture in exchange for certain intellectual property rights.

The CSR founding team had worked together at CCL for a number of years developing expertise in building high frequency radio systems with radio, computing and software functions integrated together as a single chip integrated circuit (IC). These were outsourced for production on a high volume, low cost, bulk CMOS (silicon chip) process.

The team formed CSR to develop single chip wireless solutions and selected the Bluetooth standard for its first product. Subsequent rounds of funding attracted strategic investors including ARM, Capital Research, Compaq, Intel, Philips, Siemens, Sony and, in the pre IPO round, financial investors Scottish Equity Partners and Lloyds Development Capital. CSR raised a total of \$84 m funding and delivered its first profit in the third quarter of 2003, by which time the Company had introduced its third generation of Bluetooth products. The IPO of 2 March 2004 at a price of £2.00 per share was oversubscribed. CSR technology now has over 40% overall market share for Bluetooth units, and is now gaining over 60% of Bluetooth device design wins.

The Brumark case

The *Brumark* case is a remarkable example of unexpected consequences. *Re Brumark Investments* [2001] UKPC 28 has thrown significant doubt on the ability of banks to use a fixed charge over book debts. *Brumark* is still a Privy Council ruling and has not been tested in the House of Lords, it has created sufficient uncertainty to have a major impact on the appetite of banks for overdraft and debenture lending.

In *Brumark*, on appeal from New Zealand, the Privy Council reviewed the law on fixed charges over book debts, in particular whether a charge over uncollected book debts which left the company free to collect them and use the proceeds in the ordinary course of business was a fixed or floating charge. The Privy Council described the approach to deciding whether a charge is fixed or floating: first, ascertain the intent of the parties; secondly, characterise the party's intentions as a matter of law.

The key difference in approach between the Privy Council and the previously accepted legal position was that the Privy Council determined the intention of the parties by examining the nature of rights and obligations which the parties intended to grant each other rather than looking at the label the parties used to describe the charge. The relevant intention is whether the chargor should be free to deal with the charged assets and withdraw them from the security without the consent of the holder of the charge. In *Brumark*, the Privy Council found that this was the case and accordingly concluded that the charge was not properly construed as a fixed charge. The ruling has increased the reluctance of banks in many instances to advance loans to small firms, though in some instances invoice discounting may be used instead.

(such as management training or the provision of specific credit criteria) the clearing banks as a whole are failing to play as active a role in this key area of the UK economy as they could. The issue was succinctly put forward by the Bank of England in 1996, but limited progress has been made since then:

“Banks are not normally an appropriate source of risk capital for small technology-based firms at early-stages [...] They do, however, have an important role to play in providing working capital and assisting such firms to obtain packages of appropriate finance, as well as providing other banking services.”¹⁴⁹

3.14 Examples of banking services, not primarily debt related, that may assist a young technology firm once a relationship with a bank has been built include:

- Transactional banking, such as a business current account, telephone banking, electronic banking and payroll services.
- Savings facilities, for maximising the value of equity funding before it is spent on research or recruitment.
- Trade services, since many young technology firms engage in international trade at an earlier stage than other SMEs¹⁵⁰.
- Treasury products, such as foreign exchange or interest rate hedging.
- Merchant services, to enable processing of debit and credit card payments.
- Leasing and hire purchase facilities for the purchase of equipment¹⁵¹.
- Invoice financing for managing debtor books and providing bad debt insurance.
- Insurance services, from cover for product or public liability, to professional indemnity for the provision of advice or services, to keyman or intellectual property rights insurance, and (more recently) cyber media liability for losses from email or internet use.

3.15 None of these services can be obtained unless a bank is prepared to take on technology customers in the first instance, not necessarily as borrowers. This implies that the bank must understand the nature of the company's business and not merely act as ‘pawnbroker’ for credit customers. And unless a clearing bank takes on such customers in the first place, it will have no opportunity to cross-sell higher-margin services such as investment banking or private equity.

¹⁴⁹ Bank of England (1996) p16.

¹⁵⁰ Cowling *et al.* (2005).

¹⁵¹ Leasing of assets with a risk of third party liability (such as medical equipment) can be difficult to obtain, as can those of a highly specialised nature, where future resale values can be difficult to predict.

HSBC Technology Appraisal Scheme

One of the fruits of HSBC's long-term partnerships with Brunel University and the University of York was the evolution of a template for identifying and quantifying the uncertainties surrounding a technology proposal. Originally developed by Professor Clive Butler of Brunel University, the template covers eight key areas, and in each case seeks to attribute a score out of 10 according to pre-set criteria:

- Will the product work? How well?
- USP – How innovative is it?
- How does it satisfy a market sector?
- What is the product's timeliness?
- What is the longevity of the product or product line?
- Does it fit into a family of products to permit company development?
- What is the management's previous record of innovation?
- What is the position on intellectual property rights?

Each factor is weighted, and the scaled product score is designed to highlight weaknesses. Questions specific to life-sciences were devised by Professor Tony Robards of the University of York and have over time been grafted onto the original template, designed for use in IT and engineering. Companies being considered as potential customers by HSBC could be evaluated through one of the bank-sponsored chairs of innovation according to this template, at no cost to the company and subject to written confidentiality agreements. Areas of weakness highlighted could be addressed before external equity funding was sought. And concentrating the appraisals in the hands of the chair-holders ensured both consistency and the build-up of considerable tacit knowledge. By its fifth year of operation in 2003, some 120 companies a year were benefiting from the HSBC scheme. Further information is set out at Annex C – Brunel University/University of York joint scoring protocol.

Summary

3.16 Perhaps because of the profitable opportunities elsewhere¹⁵², the British banks collectively have served the technology market poorly, and hitherto at least no overseas competitor has attacked the gap in the market. There is considerable scope for policy issues to be tackled at an industry level. For instance, the overall size of the technology market is hard to quantify (reliance on SIC codes alone has proved ineffective), as is its potential future growth. Nor has any serious attempt been made to scope the potential value of intangible assets such as patents from a lending point of view. A thorough quantitative review of the innovation market is likely to reveal profitable opportunities for specialist product development (such as venture leasing), opportunities which may be taken up by the UK banks themselves or by specialist third parties.

3.17 This chapter has concentrated on banks. For a review of the role of other financial institutions, see Sir Peter Williams' Group's second report on SET and the City to spell out the role of pension funds, insurance companies and fund managers.¹⁵³

152 Or perhaps still winded from their involvement with another difficult sector, the far more glamorous and expensive one of investment banking: "In only one of [BZW's] eleven years of existence – in 1993 – did it make enough profit to silence its detractors. It made millionaires of many of its employees, but from first to last it probably cost Barclays shareholders the best part of two billion pounds." Vander Weyer (2000) p262. One percent of Barclays' losses alone (£20m) would constitute a reasonable seed fund.

153 This report is now available from www.etechnology.co.uk

Combining Entrepreneurship and Finance

At various junctures, before and during the past forty years, numerous practitioners have sought to identify and quantify an 'equity gap', or more generally a 'funding gap'. The Macmillan committee (1931), ICFC (1945), the Bolton Report (1971), the HSBC Enterprise Funds (1992 onwards) and the recent government experiments with Regional Venture Capital Funds (set up between 2002 and 2003), Venture Capital Trusts (Finance Act 1995) and Enterprise Capital Funds (2006) spring from a recognition that capital markets do not always operate efficiently if left to themselves. One recurring problem with the funding gap is that, like the Irish Question in *1066 And All That*, as soon as it has been identified so that it might be addressed it re-emerges somewhere else:

"Gladstone [...] spent his declining years trying to guess the answer to the Irish Question; unfortunately, whenever he was getting warm, the Irish secretly changed the Question [...]"^I

Keynes famously remarked that "Practical men, who believe themselves to be quite exempt from any intellectual influences, are usually the slaves of some defunct economist".^{II} It is possible that a similar effect may be taking place within the dismal science itself, with consequences for financial theory. Both modern finance and economics are steeped in metaphors derived from physics:

"If stock prices vary according to the square root of time, they bear a remarkable resemblance to molecules randomly colliding with one another as they move in space. An English physicist named Robert Brown discovered this phenomenon early in the nineteenth century and it is generally known as Brownian motion."^{III}

"the progenitors of neoclassical economic theory boldly copied the reigning physical theories in the 1870s [...] they copied their models term for term and symbol for symbol, and said so."^{IV}

As noted above, neo-classical theory did not require entrepreneurs because it assumed perfect information, rational choice, output completely defined from a set of inputs and no inconsistent elements. In this it closely resembled 'classical' physics. Consider, for instance, Stephen Hawking's summary of Pierre Simon de Laplace's^V *Principle of Determinism*:

"In effect what he said was, that if at one time, we knew the positions and speeds of all the particles in the universe, then

we could calculate their behaviour at any other time, in the past or future."^{VI}

These implicit assumptions, common in microeconomics^{VII} at least until the recent evolution of theories on information asymmetries^{VIII}, were important also in financial theory. For instance, 'irrelevance theory', which helped Franco Modigliani (1985) and Merton Miller (1990) win the Nobel Prize for economics, states that a firm's financial structure—proportions of debt and equity, dividend policy—make no difference to its total value; financial structure only changes who benefits from how a corporation is funded. Therefore, neither managers nor owners should devote time to issues such as gearing or dividends; instead, they should simply maximise the value of their firm^{IX}. However, irrelevance theory is only true in exceptional circumstances, because it is based on the following assumptions:

- No taxes exist
- No transaction costs exist
- Individuals and corporations borrow at the same rates

The point of the 'M&M model' is that it shows that if capital structure matters, it is *precisely* because one or more of the assumptions have been violated. In practice, an investor cannot adopt the detached view implicit in the irrelevance theory but must operate at a much more micro-level. For instance, modern corporate finance theory now acknowledges the importance both of agent-principal problems (corporate insiders need not act in the best interests of owners or providers of funds) and information asymmetries (vendors and managers as insiders are likely to know more about the firm or its assets than passive owners or prospective purchasers)^X.

Agency concerns are usually seen as a *problem or cost* to be controlled through appropriate corporate governance, controls (such as audits) and incentives (including share option schemes). However, in the context of entrepreneurial finance, the issue can be turned round such that agency issues are an *opportunity*: with the right entrepreneurial team, supported by the right venture investors, information asymmetries *vis à vis* the rest of the market—rather than *vis à vis* owners—can be exploited to create opportunities that did not exist before. The skill, experience and creativity of the entrepreneur together reduce the investor risks. Schumpeter saw the joy of *creation* as part of the innovator's mindset:

"First there is the dream and the will to found a private kingdom, usually, though not necessarily, also a dynasty. Then

I Sellars & Yeatman (1930) p116.

II Keynes (1964) p383.

III Bernstein (1992) p22.

IV Mirowski (1989) p3. We are grateful to Mr Finbarr Livesey, Director of the Centre for Economics and Policy at the Institute for Manufacturing, Cambridge University, for drawing our attention to Mirowski's work.

V Laplace (1749–1827); his *Introduction à la Théorie Analytique des Probabilités* was published in 1812.

VI Stephen Hawking, Public Lectures: Does God Play Dice?; <http://www.hawking.org.uk/lectures/dice.html>

VII 'Classical' business owners relied on the price mechanism of wages and interest rates to determine the relative proportions of labour and capital to be used but did not look for new products or new techniques of production.

VIII Akerlof (1970) pp 488–500. Akerlof won the Noble Prize for Economics in 2001 with Michael Spence and Joseph Stiglitz. See also Arrow (1963).

IX Modigliani & Miller (1958) The M&M model was extended to take account of taxation in 1963.

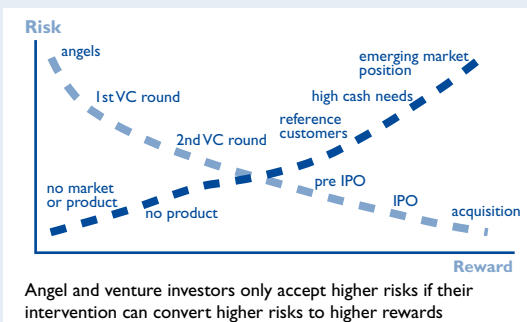
X See further in Tirole (2006).

there is the will to conquer: the impulse to fight, to prove oneself superior to others, to succeed for the sake, not of the fruits of success, but of success itself. Finally, there is the joy of creating, of getting things done, or simply exercising one's energy and ingenuity.”^{XI}

Schumpeter's emphasis on the importance of the intervention of the entrepreneur in economic progress is analogous to Say's conclusion that entrepreneurs are the fourth factor of production, along with land, labour and capital; they are not *passive* observers or interchangeable units of labour but *individuals* whose intervention forms a critical part of the economic system. Analogies derived from physics can easily be pushed too far in the social sciences^{XII}, nevertheless it is tempting to see creative entrepreneurs as being like the observer in quantum mechanics: two electrons in a singlet state and the observer form part of a single system; electron A cannot say if it is up or down until the observer measures electron B. Similarly, only the intervention of an entrepreneur with the appropriate backing can turn a new technology into a new market. Put in more conventional terms, but ones still relevant to Schumpeter:

“In the Austrian view, exchange takes place only where each party values the good he gains more than the good he surrenders. By repudiating the spurious principle that exchange is an equality [implicit in neoclassical economics based on nineteenth century physics], the problem of conservation of utility disappears.”^{XIII}

Figure 3-1: Adapting the risk/reward ratio



Given the dynamic complexity of technology-based new ventures, it is perhaps not surprising that funding for the sector is perennially hard to access. Both angels and venture capital investors rely heavily on experience, which together with extensive networking, is at least as important as technical tradecraft such as compiling term sheets and financial projections. Entry to the market by new practitioners will therefore be slow. Investment in funds by institutions has also been held back by the relative lack of success of the European

XI Schumpeter (1961) p93.

XII “The book grew out of the now-famous IPO hoax in which one of us published, in the American cultural-studies journal *Social Text*, a parody article crammed with nonsensical, but unfortunately authentic, quotations about physics and mathematics by prominent French and American intellectuals.” Sokal & Bricmont (1998).

XIII Gordon (1991) p127.

venture sector when compared with its better-established US counterpart. This should change as longer-established UK firms provide successes.^{XIV}

In considering the relative dearth of risk capital and experienced investors to manage it, the observations of two of the founders of the ARDC, the first formal venture fund, should be borne in mind, for they make clear that even in 1947 the industry pioneers in Boston recognised that only a small minority of proposals would ever be suitable for classic venture capital—though their economic impact would be out of all proportion to their size—and that the firms investing it would be contributing far more than just cash, making it hard to scale up to rival in size even the merchant banks of the 1950s:

“The post-war prosperity of America depends in large measure on finding financial support for that **comparatively small percentage of new ideas** and developments which give promise of expanded production and employment and an increased standard of living for the American people.”

Ralph Flanders, organiser of ARD, 1st January 1947^{XV}

“The Company is **not a form of bank**. It is a builder of new enterprises. **Money, skill, knowledge and men** are the tools it will use in a program requiring careful planning and long-range thinking.”

Georges Doriot, founder of ARD, 1st January 1947^{XVI}

As for addressing market weaknesses in the provision of institutional funding to early-stage specialist venture funds, UK investors and policy makers alike may remember that when ARDC was established, what is now seen as the originator of one of the most successful post-war industries in the US, it needed its sponsors and investors to think beyond the parameters of their previous experience:

“Had not the investment bankers associated with this new company been willing to do a **great deal more than ordinarily is expected** of them, the new venture might well have died aborning.”

Frank King, journalist, 1946^{XVII}

XIV A report by the *Milken Institute* in October 2005 (Barth *et al.*, 2005) included as its first key finding “The United Kingdom moves to first place in the ability of entrepreneurs to access capital.” It is understandable that government ministers should cite this study, but since it also concluded that Saudi Arabia is in joint first position with Kuwait for having a perfect macro-economic score, the survey conclusions may be of more interest to students of statistical methodology than to entrepreneurs seeking to set up in business.

XV Etzkowitz (2002), p91; emphasis added.

XVI Etzkowitz (2002), p93; emphasis added.

XVII Etzkowitz (2002), p93, emphasis added.

Universities

"The science base is the absolute bedrock of our economic performance"

Tony Blair¹⁵⁴

"[...] universities are no different from businesses in the sense that they compete with each other for grants, faculty and students, and they make money by licensing and asserting their patents against others. They cannot, therefore, expect [licensing fee] exemption to apply automatically. This judgment sent shockwaves throughout the academic world, but it should not have done. It merely confirms an ancient proverb: as ye sow, so shall ye reap."

The Economist¹⁵⁵

"I find that the three major administrative problems on a campus are sex for the students, athletics for the alumni and parking for the faculty."

Clark Kerr (1911–2003), former President of the University of California ¹⁵⁶

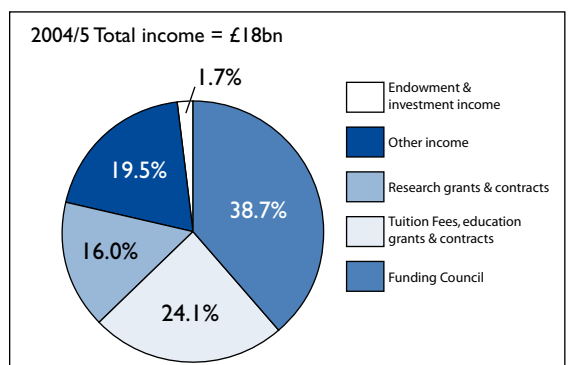
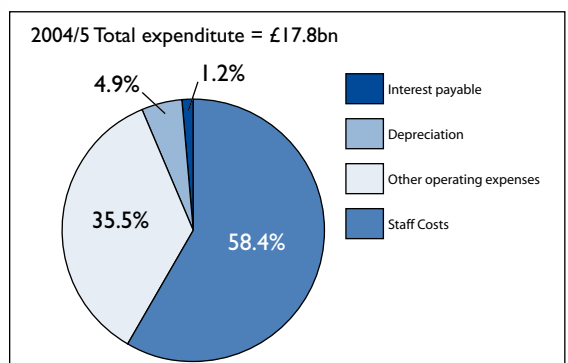
UK Higher Education Institutions

4.1 The UK has 168 Higher Education Institutions (HEIs) that vary in size between student enrolments of over 30,000 down to just a few hundred¹⁵⁷. External research income to HEIs ranges from over £180m¹⁵⁸ per annum for the top tier institutions, down to zero for those that focus only on teaching activities. Balance of income and expenditure for UK HEIs are given in Figure 4-1.

Emergence of the 'Third Mission' for UK HEIs

4.2 Commercialisation activities have long suffered from a poor image in the UK, particularly when compared to the US. Significant progress has been made since the late 1990s both in the volume of activities and in the implementation of structures and frameworks supporting research commercialisation. In 1985, the termination of the British Technology Group's monopoly on the ownership of intellectual property rights generated by academics provided universities with the right to exploit their own inventions. In 1993, the UK Government White Paper *Realising Our Potential: A Strategy for Science, Engineering and Technology*¹⁵⁹ reflected a growing policy interest in

Figure 4-1: Income and expenditure of UK HEIs 2004 - 2005



Source: www.hesa.ac.uk accessed July 2006.

¹⁵⁴ As quoted on the Office of Science and Innovation website.

¹⁵⁵ *The Economist*, (2005), "Baying for blood or Doling out cash?", 20 December 2005.

¹⁵⁶ Quoted by Alan Ryan, "Legacy of a Witty Populist", *Times Higher Education Supplement*, 12 December 2003, p22

¹⁵⁷ Higher Education Statistics Agency (<http://www.hesa.ac.uk>); not included in this above figure is the Open University which is by far the largest HEI with over 150,000 students enrolled on its distance learning programmes. See also www.universitiesuk.ac.uk.

¹⁵⁸ This figure refers only to external research funding provided by industry, charities and the research councils. It excludes 'core' funding provided by the UK Government, part of which is used to support research activities.

¹⁵⁹ "Realising Our Potential led to a complete overhaul of the organisation of government support for science and technology in the UK, including

innovation from the science base, a theme developed steadily since then.

- 4.3 Before examining these developments, it is worth placing them in the context of the evolution of the higher education sector in the UK. Since the birth of the medieval university, the roles attributed to academic institutions have evolved according to two main perspectives on teaching and research:
- the ‘classical university’ generates and transmits knowledge through research conducted for its own sake, and teaching aiming to develop the full potential of students;
 - the ‘technical university’ focuses on training students with knowledge and skills that are useful for society and on creating knowledge of direct societal benefit¹⁶⁰.
- 4.4 In many respects, these two perceptions of a university’s functions in society colour current views on what a ‘third mission’ means for UK HEIs. This third mission can be taken, for the purposes of this discussion, to be one that seeks the explicit integration of an economic development mission with the traditional university activities of scholarship, research and teaching.
- 4.5 Current developments have also been seen as the emergence of a new ‘social contract’ between science and the university on the one hand and society and the state on the other. The simple social contract that emerged in the 1950s drew on a dissemination model of innovation whereby publicly-funded basic research flows to the economy through a linear process. The progressive awareness of the inadequacy of this model and the constraints on public funding for research led to the suggestion that a new social contract should be drawn up. It would reflect the social accountability of scientists, engineers and technologists and the requirement for these disciplines to address social and economic needs¹⁶¹.

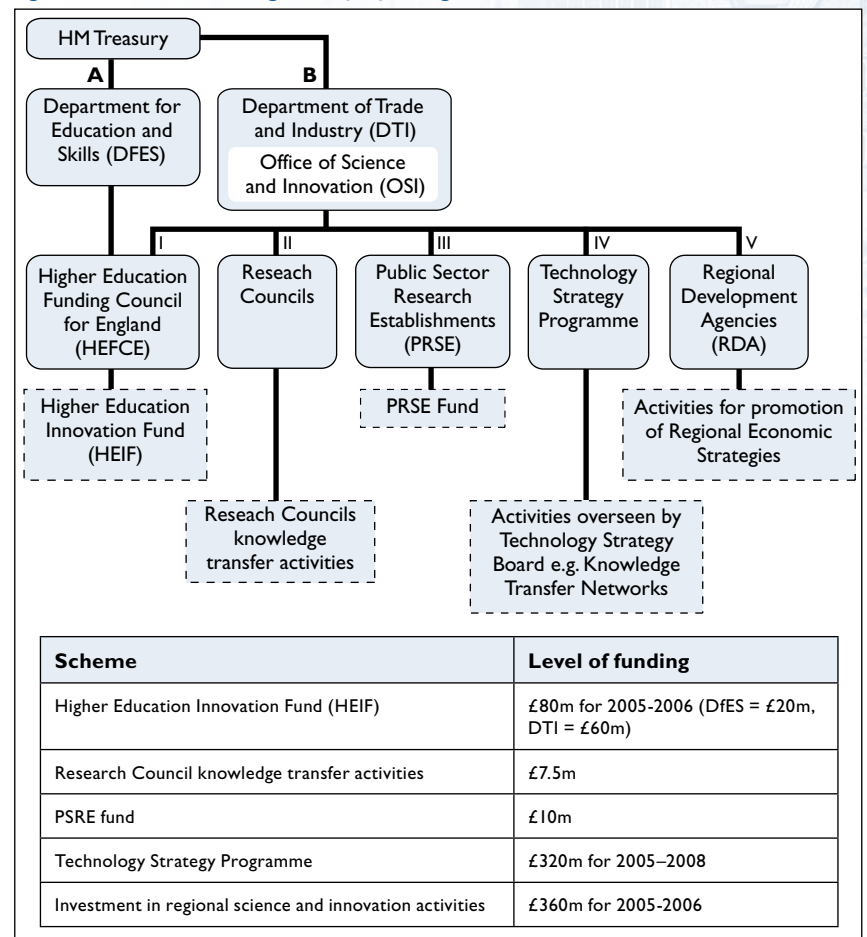
Government Schemes for Third Mission Activities

- 4.6 Third mission activities are now taken to encompass a wide range of ‘interaction’ or ‘collaboration’ programmes that include both socially and commercially focused activities. Since 1998, the government has launched a number of funding schemes to support HEIs in developing their capacity to commercialise knowledge generated through research activities. The most important are summarised in Table 4.1.

Table 4.1: Example UK Government funding streams to support ‘third stream’ activities

Start year	Initiative	Purpose	Details
1998	Higher Education Reach Out to Business and the Community (HEROBaC)	Funding to support activities to improve linkages between universities and their communities.	£20m per year allocated to provide funding for the establishment of activities such as corporate liaison offices.
1999	University Challenge Fund (UCF)	Seed investments to help commercialisation of university Intellectual Property Rights.	£45m was allocated in the first round of the competition in 1999, (with 15 seed funds being set up) and £15m in October 2001. 57 HEIs now have access to this funding.
1999	Science Enterprise Challenge (SEC)	Teaching of entrepreneurship to support the commercialisation of science and technology.	SEC provided £44.5m through 2 rounds of funding. There are now over 60 HEIs participating in SEC-funded activities.
2000	Higher Education Innovation Fund (HEIF)	Single, long term commitment to a stream of funding to “support universities’ potential to act as drivers of growth in the knowledge economy”.	HEIF was launched in 2000 to bring together a number of previously independently administered third stream funding sources. This was then extended (HEIF2) in 2004 with £185m awarded, and HEIF3 funding will commence in 2006.
2000	Cambridge-MIT Institute	A range of research projects and education activities to drive improvements in the UK’s competitiveness, productivity and entrepreneurship.	£65m for a five year programme of activities.

Figure 4-2: Public knowledge transfer funding streams



the Office of Science and Technology’s move from the Cabinet Office to the Department of Trade and Industry (DTI) in 1995.” (<http://www.britishcouncil.org/science/gost/rop.htm>).

160 Martin and Etzkowitz (2000); Druilhe (2002).

161 Guston and Keniston (1994).

- 4.7 The funding of universities' third mission activities is drawn from a range of knowledge transfer sources as shown in Figure 4.2.

Metrics for Commercialisation Activities

- 4.8 With the support provided by funding schemes such as those in Table 4.1, UK HEIs have developed new central structures to manage commercialisation and collaborative activities, such as industrial liaison offices, entrepreneurship centres and policies to manage intellectual property rights. Research commercialisation activities have increased, whether through patenting/licensing, spin-outs or consulting¹⁶². The expenditure of government money on supporting such activities has been linked to a desire to measure its effectiveness and efficiency.
- 4.9 The government has been keen to show that third stream funding activities have led to a marked increase in activity and that this has led to useful outcomes. One way of viewing the performance of third mission activities is to view universities in terms of inputs, outputs and outcomes. Various output measures can be used including papers (to show volume of output), citations (to show quality of output) and various commercialisation indicators such as invention disclosures, patents, licence deals, income from licences, income from consultancy, number of spin-outs, value of spin-outs, funding raised by spin-outs and many more. However, limiting metrics to the relatively easily measurable may result in interactions between universities and businesses which are 'fuzzier', but nonetheless very useful, being ignored.
- 4.10 When comparing the UK to the US, this reveals some positive indicators for the UK (but also highlights the huge scale difference between the two nations' commercialisation activities) (See Table 4.2).
- 4.11 Aside from giving the policy makers a sense of how much value for money is being derived from activities funded by the public purse, performance measurement has a direct impact upon HEI funding. The bulk of HEIF3 funding for universities is now being awarded on a formula-driven, rather than bid-for, basis. If HEIs can show that they have strong performance against key performance indicators, they will automatically receive on-going funding for their third mission activities.
- 4.12 The risk of using such a formula-driven approach is that it encourages HEIs to 'play the system' and may result in the channelling of resource into inappropriate activities. For example, research on knowledge transfer in Germany shows that simply encouraging

Table 4.2: Comparative commercialisation performance of UK HEIs and US universities

	US universities AUTM survey	UK HEIs HE-BCI survey
Number of institutions	156	165
Industrial research expenditure (£000s)	1,599,540	201,770
Public research expenditure (£000s)	13,436,675	2,220,742
Total research expenditure (£000s)	21,081,281	3,418,501
New patents granted	3,109	371
Licences	3,739	758
IP income from licensing, other and spin-off sales (£000s)	643,166	37,079
Spin-off companies formed	364	197
Research expenditure (£million) per patent	6.78	9.21
Research expenditure per £ of licence income	32.78	92.20
Research expenditure (£million) per spin-outs	57.92	17.35

Source: Livesey et al. (2006).

universities to increase the numbers of spin-out ventures can lead to ideas being prematurely packaged into new ventures that have little chance of attracting funding and hence growing to make a positive contribution to the economy¹⁶³.

¹⁶² For data on university commercialisation activities, see www.hefce.ac.uk

¹⁶³ Gill et al. (2003).

Too Many or Too Few Spinouts?

- 4.13 The economic boom of the late 1990s, coupled with funding for innovation support mechanisms, resulted in an upsurge in spin-out activity from UK HEIs. In part this was driven by an implicit (and many cases explicit) belief that spinning-out ventures based around HEI-owned intellectual property could generate significant direct returns to the host HEI. Examples of the returns generated by spin-outs from MIT were often used as an example of such¹⁶⁴. During this buoyant period, commercialisation offices within UK HEIs were strongly encouraged to create spin-outs.
- 4.14 However, the bursting of the Internet-driven economic bubble in 2000, coupled with closer examination of data on US university spin-out activity, led to a realisation that the likelihood of spin-outs generating significant direct returns to the parent HEI was extremely remote¹⁶⁵. The Lambert Review¹⁶⁶ increased discussion of this issue by raising concern at a perceived over-focus on spin-out activities. Licensing of IP to established firms, the report indicated, might be a more reliable route to getting ideas from university labs to industry application. This prompted further research and discussion that sought to reveal the role that spin-outs can usefully play within the commercialisation strategies of different types of HEI. Three examples of such research are as follows.
- “Too few university spin-out companies¹⁶⁷”: A paper from Ederyn Williams of Warwick University that highlighted the flaws in comparing US and UK commercialisation activities directly, when these activities are at markedly different levels of maturity. Seeking a more balanced comparison shows that the UK is performing extremely well.

164 The oft-cited figures are as follows: “If the companies founded by MIT graduates and faculty formed into an independent nation, the revenues produced by the companies would make that nation the 24th largest economy in the world. The 4,000 MIT-related companies employ 1.1 million people and have annual world sales of \$232 billion”. BankBoston (1997)

165 The report of a 1998 Committee of Vice-Chancellors and Principals (CVCP, now Universities UK) mission to the US funded by the Gatsby Charitable Foundation, Technology Transfer - the US Experience, provided a balanced picture of activity and experience at leading US universities. For latest data on the commercialisation performance of US universities, see www.autm.org.

166 Lambert (2003). One of the more enduring legacies of the Lambert Review was a set of model agreements setting out intellectual property rights when universities deal with industry, especially smaller firms. See www.innovation.gov.uk/lambertagreements

167 Williams (2005).

Another way of funding university spin-outs?

IP Group (previously IP2IPO^I) grew out of a deal in November 2000 when Beeson Gregory, an investment bank, announced a joint venture with Oxford University under the terms of which Oxford's Chemistry Department received £20m from Beeson Gregory to build new laboratories and to continue to attract leading scientists. IP2IPO works with Isis Innovations, Oxford's technology transfer company, to identify spin-out companies from the department. Beeson Gregory transferred its interests to its subsidiary, IP2IPO, in August 2001.

In return for its up-front investment, IP Group will acquire half of Oxford's equity entitlement in companies spun out of the Chemistry Department over the following 15 years. A year later, in December 2001, IP Group acquired an interest in Inhibox Limited, a computational drug-discovery company, as the first venture arising from its agreements with Oxford.

IP Group subsequently completed a range of similar agreements with other UK universities: Southampton (March 2002), King's College London (May 2003), York (September 2003), Leeds (January 2005, via the acquisition of TechTran), Bristol (December 2005), Surrey (February 2006) and Manchester (March 2006, through its Modern Biosciences subsidiary).

In October 2003, IP2IPO floated on the Alternative Investment Market. It transferred to the Official List of the UK Listing Authority in June 2006, by which time it had taken stakes in 37 companies. Beeson Gregory (by then known as The Evolution Group) had reduced its holding to below 20% in May 2004.

In mid-2006, Oxford University signed another deal comparable to IP Group's arrangement with the Chemistry Department. On 29 June 2006, the London-based fund Technikos provided an initial £12M to help fund the new Institute of Biomedical Engineering. The deal also includes the provision of commercial advice and assistance. In return, Technikos will obtain 50 per cent of Oxford's portion of the equity in any Biomedical Engineering spin-out. Technikos will also receive 50 per cent of the University's share of royalties from licensing biomedical engineering technologies developed during the 17 year period of the agreement^{II}.

Each of these models requires long-term investment, with IP Group's partnerships typically having a 25 year duration. They focus on science-based firms straight from university departments with high academic rankings, rather than entrepreneur-led businesses: “It's nice to be involved in commercialising science. Not many people are willing to take the risks,” George Robinson, Chairman of SPRE (of which Technikos is an operating division), was quoted as saying^{III}.

They differ, however, in that IP Group is now a publicly-quoted company with a wide range of external shareholders (£16.8M was raised in June 2006, on top of £3M in March 2002, £6.1M in May 2003, £30M in October 2003 and £13.7M in May 2005) whereas Technikos is funded by SRPE, set up in 2005 as the autonomous private equity arm of Sloane Robinson, an international investment group, founded by Hugh Sloane and George Robinson in 1993.

That said, Technikos may float in due course if the project is sufficiently promising. The IP2IPO experience suggests that partnerships with universities are cash-hungry and the time required to grow an investment for sale or flotation means that the delay before a return on investment is seen may be significant. Mr Robinson previously donated £6m to Keble College in Oxford to build a new arts centre. A graduate scholarship programme was also funded through the Sloane Robinson Foundation.

I www.ip2ipo.com/ accessed 3 July 2006

II <http://www.admin.ox.ac.uk/po/060629.shtml> accessed 3 July 2006

III *Daily Telegraph* 29 June 2006. Compare the emphasis on basic science on the IP Group's home page: “UK scientists produce about 8% of the World's scientific papers and win around 10% of the internationally recognised scientific prizes (including 90 Nobel prizes, the second highest number of any country).”

- “University spin-outs: Starting to fill the evidence gap¹⁶⁸”: A report for the Gatsby Charitable Foundation that highlighted the fact that neither HEIs nor their spin-outs are homogenous groups. The report identified three broad categories of HEIs, and at least three types of spin-outs. This highlighted the need to gain more granularity when seeking to analyse HEI spin-out performance.
- “Creating success from university spin-outs¹⁶⁹”: This report from the BVCA focused in particular on the role that VCs can play in supporting high growth potential spin-outs from HEIs.

Licensing

- 4.15 Improved understanding of how difficult it can be to generate direct returns from spin-outs has increased the interest in licensing technologies to established firms. For some HEI technology transfer offices, their focus is to “find the best way to get technology and expertise out there, by patenting or licensing or whatever route is appropriate¹⁷⁰. If a technology is readily licensable (i.e., does not need substantial additional resource applied to make it useable to an identified customer) then the inventor will be encouraged to take the licensing route. If it is clear that the idea does need additional development (and hence resource applied to it) then the spin-out route may be encouraged.
- 4.16 However, the licensing strategy for commercialisation also can be problematic. For example, research from the US shows that universities which are over-aggressive in negotiating licences can harm their own efforts to raise other sources of funding from industry¹⁷¹. The extent to which universities are able to form the types of relationships with industry required to develop a strong portfolio of licenses depends very much upon the university’s perceived prestige. There are also the ‘demand deficiency’ issues raised by the Lambert Review (i.e., highlighting the fact that while universities have made good efforts to increase their openness to industry, many companies do not yet have the capability to get best value from working with universities)¹⁷².
- 4.17 Research from the US is also showing some problems with the licensing business model. Universities have traditionally been able to access patented IP for research purposes on a fee-exempt basis. However, companies are increasingly reluctant to allow this as they are concerned that universities are not just seeking to develop new knowledge based on the IP, but will at some time of the future seek to exploit this knowledge commercially¹⁷³.

168 Minshall and Wicksteed (2005).

169 BVCA (2005).

170 Interview with Dr Jeff Skinner, Commercial Director, UCL Business on 9 October 2003.

171 FCO (2003).

172 Lambert (2003)

173 “Scholars for Dollars”, *The Economist* 9th December 2005 accessed

A Broader View of Knowledge Transfer

- 4.18 There is increasing interest in the UK in forms of knowledge transfer beyond spin-out and licensing. This can be seen in through the emergence of the ‘people centric approach’¹⁷⁴ as described in the box “Idea versus People Centric Policies”. Recognition of the fact that the ‘best’ form of knowledge transfer is through people moving from one context to another has led to increased interest in a ‘people centric’ rather than ‘idea centric’ view. Examples of this can be seen in elements of government knowledge transfer policy such as the use of Knowledge Transfer Partnerships (PhD researchers working in firms), the various activities being piloted by the Cambridge-MIT Institute (CMI)¹⁷⁵, and some of the activities of the London Technology Network¹⁷⁶.
- 4.19 There is also recognition that there are many different approaches to knowledge transfer, and that different organisational structures may be needed to allow the exchange of different types of knowledge. For example, for the transfer of ‘packaged’ IP (such as that which can be captured in patents), a centralised organisational structure along the lines of a ‘traditional’ technology transfer office working predominantly to support the licensing of IP to new and established firms may be most appropriate. However for more tacit knowledge transfer, a structure which supports a ‘people centric’ approach may be more effective. Such a structure may be one which is embedded within a specific university department rather than as a central university resource. By way of illustration, the activities of Cambridge Enterprise¹⁷⁷ and the University of Cambridge Institute for Manufacturing¹⁷⁸ represent these contrasting yet complementary approaches to knowledge transfer.

Summary

- 4.20 UK HEIs that seek to commercialise the outputs of research have been through a period of experimentation over the past 8 years. This experimentation has been fuelled by government initiatives that have allowed the HEIs to apply resource to existing and new activities to bring technologies to market. Inevitably, during this learning phase, government support for differing types of commercialisation activity was delivered through

via www.economist.com.

174 A term coined by Stephen Allott, a successful manager who returned to Cambridge University to found the Cambridge University Computer Laboratory Graduate Association (the ‘Ring’) – <http://www.camring.ucam.org/>

175 www.cambridge-mit.org

176 www.ltnetwork.org

177 www.enterprise.cam.ac.uk

178 www.ifm.eng.cam.ac.uk

Idea versus People Centric Policies

In a recent paper delivered as the 2006 Cambridge University Hughes Hall City Lecture^I, Stephen Allott drew on both his own experience and US research to criticise government policy on innovation, especially business-university co-operation. Analysing the Lambert Review's self-understanding of its task, Mr Allott noted the extent to which recent British policy makers have relied on a 'linear model' or 'idea centric' approach to commercialising technology, especially university research. The people-centric approach to the innovation process "starts with a customer problem, uses a PhD and the PhD's training to solve that problem" and thereby creates value^{II}. Government policy, however, starts with research, which in turn seeks a practical application^{III}.

So pervasive is this policy agenda that among government advisers it is now accepted subliminally. Mr Allott analysed the Lambert Review's own description of its mission and concluded:

"This is about the economic impact of research and universities.

To answer this question, one would need to understand how the science to growth mechanism works. The technology transfer focus emerged in the next sentence:

"The context of this review was a sense that the UK performs well in terms of the academic quality of its science and technology base, but is not as good as other countries at commercialising the knowledge generated in its universities as some other countries, notably the USA."

'Here we have the smoking gun: they have leapt to the conclusion that the mechanism is the linear model, that it's technology transfer and that it is Idea Centric. The UK Government believes that American universities have been good at technology transfer and that it's through technology transfer that Silicon Valley has grown up. Outside pharma this doesn't appear to be supported by the evidence.'^{IV}

I Allott (2006).

II Allott (2006) p8.

III This is sometimes called the cooperative technology policy paradigm: "In the US, the cooperative technology policy paradigm has been extremely controversial in that it goes against the strong market ethos that permeated not only science and technology policy but most realms of public policy." Bozeman (2000); cited in Allott (2006) p11.

IV Allott (2006) p10, citing http://www.hm-treasury.gov.uk/media/446/52/lambertemergingissues_173.pdf,

Element of Mechanism	People Centric Approach	Idea Centric Approach
Business idea source	Customers and manufacturing operations	Research
PhD employer	Business	University
PhD role	Looking things up	Inventing
Amount of science accessed	100%*	11%*
Timing of use of science	When needed	When invented

* British science is 11% of global total - Allott (2006) p9

Silicon Valley provided a clear illustration of the 'people centric' approach to turning scientific research into economic growth. Analysing recent large-scale successes associated with Stanford University in Silicon Valley, Mr Allott noted that "the real policy lesson is that you get a Yahoo or a Google if you have a Jerry Yang or Sergey Brin or Larry Page around. The policy lesson is not to go and trap and license the intellectual property."^V The very first 'garage' business (at 367 Addison Avenue, Palo Alto) to emerge from Stanford—Hewlett-Packard—was formed in 1939 after Walt Disney expressed commercial interest in the resistance-tuned audio oscillators already mentioned above. This pattern continued during Silicon Valley's major growth phase:

'According to Gordon Moore, co-founder of Fairchild and Intel, the defining characteristics of Silicon Valley – its business models and its sustained, technology-based growth – "were neither started nor made fundamentally possible" by the presence of the university. Stanford did play an important supporting role in the subsequent growth of the industry, by providing a stream of well-trained scientists and engineers, some of whom were hired by Silicon Valley companies, and by promoting research co-operation with local firms. Moore describes the role of the university in regional high-technology economies "as an economic institution responsive to the manpower and intellectual needs of the marketplace".'^{VI}

itself citing The Future of higher Education Department for Education and Skills, January 2003.

V Allott (2006) p13.

VI Owen (2004) p12.

separate programmes. In some cases this has led to a fragmented approach within HEIs and rationalisation is now underway.

- 4.21 HEIs realise that initiatives that have been pump-primed through soft money need either (a) further external funding, (b) to generate their own funding or (c) to become centrally funded. At the same time, the government has merged many of the previously disparate funding streams for HEI commercialisation activities under the Higher Education Innovation Fund (HEIF), which provides a formula-driven, long term

commitment from the government to support third mission activities within HEIs. These two factors, one internal the other external, are encouraging HEIs to formulate strategies that provide them with a means to build a balanced portfolio of third stream activities appropriate to their distinctive academic strengths and to their particular regional context.

- 4.22 The UK Government views HEIs as playing a key role in supporting innovation. Firstly, they provide a significant proportion of the world-class research that feeds IP into the innovation system. Secondly, they



Education—an Alternative View

Commentators have noted the slow pace at which universities in Britain embraced new scientific disciplines when compared with their counterparts in Germany, for instance. But Cambridge in the nineteenth century was not alone in emphasising the importance of science in education. As Geoffrey Owen notes,

“In London, the Royal College of Chemistry, the Royal School of Mines and the Central Technical College were merged in 1907 to form the Imperial College of Science and Technology, modelled on the technical high school in Berlin. By the time of the First World War technical education in Britain at the university level had partially recovered from the earlier lag. The output of university-trained engineers and scientists was lower than in Germany, but this was partially offset by the wide range of non-university courses which had sprung up in Britain.”^I

In fact, Owen adduces strong evidence to dispel the myth current during the 1960s and beyond that Britain lagged behind its immediate competitors in the production of technically-qualified graduates in industry. Sampson, mirror rather than anatomist of his times, stated: “Science is no longer simply an academic pursuit but, primarily, a matter of national survival [...] it seems surprising that British industry has survived at all.”^{II} But the tangible data do not support the anecdotal evidence of a rift between industry and the universities or a decline in the relative importance of science:

‘By the mid-1950s the British higher education system was turning out more science and engineering graduates than in Germany and France. A decade later, according to a report published in 1967, Britain had a larger stock of science graduates than any other West European country and employed a larger proportion of them in industry. “Britain, far from being short of scientists, is more richly endowed with them than is any country except the USA.”’^{III}

Perhaps, then, it is only in relation to the US that the disparity in graduate skills was a substantive issue: “The subsequent political row about the ‘brain drain’, as it was called by Peter Fairley of the *Evening Standard*, produced a lot of jingoistic reactions, and neglected to take into account the drain towards Britain, from the

I Owen (2000) p416.
II Sampson (1965) p374.
III Owen (2000) p417.

Commonwealth and South Africa.”^{IV} For reasons set out below, Britain is unlikely to be able to compete head-to-head with the US in innovation matters.

Given the long-term cycles involved with educational issues, it is helpful to reach back beyond the 1960s to the early twentieth century. If commentators have not succeeded in pinning Britain’s relative industrial decline on the supply of university-educated scientists and engineers, another touted culprit has been an anti-commercial bias in Britain’s schools, particularly the public schools responsible for training future social leaders and opinion-formers. An influential proponent of such a view was Martin Wiener, whose *English Culture and the Decline of the Industrial Spirit* argued that English entrepreneurs lost their drive in the second half of the nineteenth century through gentrification or social absorption via the public schools:

“The rentier aristocracy succeeded to a large extent in maintaining a cultural hegemony, and consequently [...] in reshaping the industrial bourgeoisie in its own image. The Victorian retreat of the aristocracy was more political than psychological. The landed elite gave way only slowly to industrialists [...]”^V

But here again, the evidence—either of industrial decline or of the role of the public schools in such decline—is at best limited. Noting that it ‘is highly questionable’ that British entrepreneurs failed between 1870 and 1914, Owen continues:

“[...] the public schools cannot be given the weight [Wiener] attaches to them, since a very small proportion of businessmen sent their sons to public schools during those years [...] As for the education which the public schools provided [...] the aim was not to prepare a leisured class for the life of a country gentleman, but to form ‘an active, responsible, physically fit, self-disciplined elite of professional men and administrators for public service in church and state, the empire and the liberal professions.’ The qualities which the public schools sought to inculcate – leadership, self-reliance, the willingness to back one’s own judgement – were as valuable in an entrepreneur or manager as in a colonial administrator.”^{VI}

IV Sampson (1965) p385. The *Evening Standard* article appeared in 1963.
V Wiener (2004) p8. The first edition was issued in 1981.
VI Owen (2000) pp418–9, citing Perkin (1989) p36.

provide people with the skills to bring ideas to market. Thirdly, they have been increasingly expected not just to be passive suppliers of IP, but also to be active in the generation of commercial value from their IP.

- 4.23 The government realises that significant investment is needed to ensure that the UK’s science base remains world-class. Increased funding has been promised from the science budget but this comes at a time when universities are also expected to be implementing full economic costing to all their research activities, resulting in less money directly used to fund research.
- 4.24 Encouraging universities to become directly involved in commercialisation activities is helping universities bring ideas out of the labs and into market application. However, blurring of the boundaries between research and commercialisation may present challenges in the future, as exemplified by the current debate in the US around royalty-free use of patented IP by universities.

Government Support for Innovation

"It is time that we in Britain, so good at fundamental science, also came fully to appreciate the intellectual challenge behind product development. We seem culturally unable to realise that this can be more challenging than fundamental science and requires the very best minds"

Lord Broers, Reith Lectures 2005 "The Triumph of Technology"¹⁷⁹

"Inventors: All die in the workhouse. Somebody else profits by their genius; it is not fair."

Gustave Flaubert¹⁸⁰

"When I find myself in the company of scientists, I feel like a shabby curate who has strayed by mistake into a room full of dukes"

W. H. Auden¹⁸¹

Introduction

- 5.1 Government support for innovation (i.e., the successful commercial exploitation of ideas) in the UK has been, to a large extent, blurred with that of support for invention and scientific discovery. Focusing on the latter has led to a strong emphasis on increasing the percentage of GDP that is spent on R&D, both in the public and private sectors. R&D spend as a proportion of GDP has become the main yardstick of 'innovation' performance for Europe in its efforts to deal with the continued innovation dominance of the US and Japan, and emerging innovation challenge of countries such as India and China. One instance is the EU-wide Lisbon target of 3% of GDP invested in R&D by 2010.¹⁸² The UK has itself set a lower (and probably more realistic) target of 2.5% by 2014.
- 5.2 The UK Government's view of the role of innovation within the UK's economic performance is based on the perceived impact of innovation upon productivity. For HM Treasury, the view is: "[...] productivity growth relies on a continual stream of inventions and innovations of both new technologies and improved working practices."¹⁸³ For the DTI it is as follows: "In the past, many UK-based businesses have prospered even when selling in low value markets, but today British industry faces a new challenge: how to raise its rate of innovation?"¹⁸⁴
- 5.3 But while there is clear recognition of the importance of innovation for the economic growth of the UK, the nature of the innovation is also changing. Shortening product life cycles, intensification of competition and increased product complexity are driving the need for companies in many industries to move beyond relying upon the exploitation of ideas generated through internal R&D to a more open model of innovation. Open innovation (a term coined by US academic Henry Chesbrough¹⁸⁵) requires firms to be able to generate value from ideas whether they be internally generated through R&D, or acquired from outside by licensing, partnering or company takeover. Government support for innovation needs to reflect this change.
- 5.4 The perception of the role of innovation on the performance of the UK economy (and the consequent attitudes of successive governments) has passed through a series of clear phases since the 1950s. A description of each of these phases and examples of government policies to support the different perceived needs is given in the following sections.

179 From Lecture 1: "Technology will Determine the Future of the Human Race", www.bbc.co.uk/radio4/reith2005

180 Flaubert (1850) "INVENTEUR: Meurent tous a l'hôpital – et un autre profite de leur découverte, ce n'est pas juste."

181 Auden (1963).

182 See http://europa.eu.int/growthandjobs/index_en.htm.

183 HM Treasury (2000).

184 DTI (2003a).

185 Chesbrough (2003).

1945–1960s: Rebuilding the Economy

- 5.5 In the immediate post-WWII years, the UK economy faced huge challenges in recovering from the extreme short-term demands that had been placed upon industry, together with lack of investment. This was coupled with the UK facing the ‘end of Empire’ and needing to reposition itself as an economy operating in a world very different from that which existed before the Second World War. Examples of schemes that were initiated by the government around this time to help manage the transition to peace and to support the rebuilding of the economy included the following:
- Council of Industrial Design (established 1944): Precursor to Design Council that aimed to “promote by all practicable means the improvement of design in the products of British industry”¹⁸⁶.
 - Industrial and Commercial Finance Corporation (ICFC) (established 1945): ICFC was formed by UK clearing banks, the Bank of England, The Board of Trade and the Treasury to meet the needs of smaller companies and address the shortage of long-term capital available to them for development. The idea for this corporation stemmed back to the findings of the Macmillan Committee in the 1930s¹⁸⁷. The ICFC, and its subsidiary function named Technology Development Capital (TDC), eventually became part of the UK venture capital firm, 3i.
 - Finance Corporation for Industry (FCI) (established 1945): FCI was established by the same group that established ICFC but aimed to provide finance for large scale, long-term investments needed for industrial rationalisation¹⁸⁸. The FCI also eventually became part of the basis for the UK venture capital firm, 3i.
 - National Research Development Corporation (NRDC) (established 1948): Set up by the government to commercialise British publicly funded research. NRDC was involved in the exploitation of technologies including interferon, the hovercraft and the continuously variable transmission (CVT).
- 5.6 These organisations provided a foundation upon which the government could target its resources for rebuilding the economy, but also to support innovation under the coordination of, predominately, the Board of Trade (the predecessor of the Department of Trade and Industry) and the Department of Scientific and Industrial Research¹⁸⁹.

186 Myerson (2000).

187 Coopey (1994) pp262–271.

188 Coopey (1994).

189 <http://www.dti.gov.uk/about/aboutus/history/index.html>

1960s and 1970s: Public Intervention – National Champions

- 5.7 Among the many strands of the government’s industrial policy in these two decades, three themes can be identified clearly.
- First, there was a strong move to support (or even create) larger firms through actively encouraging mergers between UK companies to form more substantial opponents for overseas (mostly Japanese and American) rivals¹⁹⁰.
 - Second is the articulation of the view that innovation exploiting scientific excellence was to be a critical element of the UK’s future success. The Labour Government of the mid-, to late-1960s saw science and technology as a key foundation of a ‘new’ Britain (as summed up in Harold Wilson’s ‘scientific and technological revolution’).
 - Thirdly, there was an emerging recognition that small firms were not only an important driver of change and innovation, but that this sector had been chronically under-supported since 1945.
- 5.8 Examples of public bodies created during this period to support the achievement of these three objectives includes:
- Ministry of Technology (MOT) (established 1964): The MOT was formed partly from the Department of Scientific and Industrial Research and partly from the Board of Trade.
 - Industrial Reorganisation Corporation (IRC) (established 1966): The IRC was set up to promote mergers in fragmented industries, working in partnerships with the newly formed Ministry of Technology.
 - National Enterprise Board (NEB) (established 1975): The remit of the NEB was to help regenerate British industry. It did this by (a) actively supporting the formation of new firms in ‘strategic sectors’ and (b) providing support for smaller firms with the aim of accelerating their growth.
- 5.9 These policy strands were implemented during a period of great social and economic change, both within the UK and internationally. The activities of the Industrial Reorganisation Corporation in merging together smaller UK firms to be stronger national champions resulted in the formation of companies such as ICL¹⁹¹. ICL was the result of the bringing together a number of smaller UK computer companies to form one organisation that it was hoped would have the potential to rival IBM in the US. ICL, though achieving some success, particularly in the design and implementation of IT systems for the public sector, did not ever become a serious rival for IBM and was in

190 Owen (2004).

191 Owen (2004).

1990 bought by Japan's Fujitsu¹⁹².

- 5.10 It has been observed that this policy of providing public support and encouragement for the development of large, vertically integrated companies at this time was “out of tune with the new economic realities”¹⁹³. The support for the creation of new firms in selected industry sectors by the NEB helped the development of biotechnology and semiconductor activities in the UK. The NEB's role in the helping smaller, high potential firms, especially in computing, had some successes (such as Sinclair Research).
- 5.11 Another example output of this approach of attempting to pick national innovation champions and supporting them through direct public funding is that of the Anglo-French Concorde project. Though widely acknowledged to be an extraordinary technological achievement, the project proved to be a long, drawn-out commercial failure¹⁹⁴.
- 5.12 At the end of the 1970s, with the UK economy struggling with high unemployment and high inflation, it became clear that the aims of this strong interventionist approach to supporting innovation and entrepreneurship had not been achieved.

1980s and 1990s: Market forces – Enterprise Focus

- 5.13 With the election of the Conservatives to power in 1979, the emphasis of government policy was firmly on the free market. Under the Thatcher Government, the agencies (such as NEB) who had been tasked with ‘picking winners’ were closed down; numerous state-owned agencies were privatised; and emphasis government support shifted strongly to creating the climate for enterprise to flourish.
- 5.14 Examples of public bodies created during this period to support the free market focused economy included:
- British Technology Group (BTG) (established 1981): BTG was formed by the merger of the National Enterprise Board and the National Research Development Corporation. BTG went on to be privatised in 1992 and listed on the London Stock Exchange in 1995.
 - Investors in Industry (3i) (established 1983): 3i was formed from the Industrial and Commercial Finance Corporation. Its activities are now focused around buy-outs, development capital and venture capital.
- 5.15 Though the Conservative Government was taking a largely non-interventionist stance to support for innovation and entrepreneurship, a number of schemes were launched by them to provide targeted funding at

BTG¹

The origins of BTG date back to the late 1940s in Great Britain when the NRDC was created to commercialise innovations resulting from publicly funded research. Over the years, many important innovations were successfully commercialised, notably the Cephalosporin Antibiotics, which still enjoy a significant market share, Magnetic Resonance Imaging and Interferon.

The BTG brand was created following the merger with the National Enterprise Board, and the company prepared itself for privatisation, which happened in 1992. Three years later BTG floated on the London Stock Exchange.

In the following years, BTG set about building its pipeline and notable events included the demerger of Torotrak, the creation of Provensis® to develop Varisolve®, and the launch of two very important products, BeneFIX®, a treatment for the bleeding disorder Haemophilia B, and Campath®, a treatment for chronic lymphocytic leukaemia. This has been followed recently with the launch of Combunox™, a painkiller, by Forest Laboratories Inc.

In May 2005, BTG announced that, in the future, it would intensify its focus on developing and commercialising medical innovations, principally in the fields of Ageing, Neuroscience, Oncology and Drug Repositioning.

¹ From www.btgplc.com

stimulating activity in these two areas. These schemes included:

- Small Firms Merit Award for Research and Technology (SMART): SMART drew upon US experience to provide small firms with relatively modest amounts of funding to test the commercial and technical feasibility of an idea, and to help these firms attract further funding.
- Small Firm Loan Guarantee (SFLG): Provided government guarantees to allow small firms to borrow from commercial banks.
- Business Start-up Scheme / Business Expansion Scheme / Enterprise Investment Scheme: These schemes allowed investors to claim tax relief on income from investments in unquoted companies and, in particular, start-ups.
- Alternative Investment Market (AIM): Though not a government scheme per se, the London Stock Exchange was strongly encouraged by the government to establish a separate market for smaller and younger firms.

- 5.16 In 1993, a government document was published that led to the reorganisation of public support for science and innovation. *Realising our potential: A strategy for science, engineering and technology* communicated a significant shift in government thinking. Science policy was conceived within the broader framework of innovation policy and this led to complete overhaul of

¹⁹² Minshall (1997).

¹⁹³ Owen (2004).

¹⁹⁴ Spufford (2003).

the organisation of support for science and technology in the UK, including the move of the Office of Science and Technology (OST) to the DTI.

Late 1990s and 2000s: Towards the Knowledge-driven Economy

5.17 In response to the changing pattern of international competition, New Labour saw the future of the UK being based around the development of a strong 'knowledge-driven' economy; and innovation and entrepreneurship were key strands in the achievement of that objective. The evolution of the current government's approach to developing the mechanisms to use innovation and entrepreneurship to drive the UK towards a knowledge economy can be tracked in the key documents as detailed in Table 5.1.

5.18 The policy documents outlined above have led to the implementation of a range of initiatives to support innovation and entrepreneurship. Examples include:

- Grants for R&D: Four types of grant are available (Research, Exceptional, Development and Micro) to assess the feasibility of a new technology and develop prototypes (See Figure 5.1). This programme extends the SMART programme as launched in the 1980s.
- Grants for investigating an innovative idea: Reimbursed consultancy to help businesses get advice on the steps needed to implement their ideas. As of June 2006, this programme was no longer running.
- Knowledge Transfer Network: A grant to an intermediary to set up a network in a priority technology area, bringing together businesses, universities and others with an interest in technology applications.
- Knowledge Transfer Partnerships: A grant to cover part of the cost of using a person to transfer and embed knowledge into a business from the UK knowledge base via a strategic project.
- Collaborative R&D: Funding for collaborative research and development projects between businesses, universities and other potential collaborators.
- R&D Tax Credit: Deduction of proportion of qualifying expenditure on research and development (R&D) when calculating taxable profit.

5.19 There have also been a series of initiatives targeted at increasing the supply of investment available to young firms seeking to exploit new technologies. These include (as detailed earlier in Chapter 2):

- Regional Venture Capital funds (RVCFs): Since 2000, over £120m has been committed by the Small Business Service and the European Investment Fund in creating a network of nine regional venture capital funds (each with, typically, £20m to £50m under management).
- Enterprise Capital Funds (ECFs): An adaptation of the equity investment activities of the US Small Business Innovation Company (SBIC) for the UK environment.

Table 5.1: Selected key innovation policy documents¹⁹⁵

Policy Document	Summary
<i>Our competitive future: Building the knowledge-driven economy, 1998</i>	Set a "co-ordinated and coherent programme of action" to close performance gap with competitors. Actions focused around capabilities, collaborations and competition
<i>Excellence and opportunity: A science and innovation policy for the 21st Century, 2000</i>	Set framework for government's role as key investor in science base; facilitator for collaboration between HEIs and business; and the regulator for innovation
<i>Opportunity for all in a world of change: A white paper on enterprise, skills and innovation, 2001</i>	Emphasised importance of innovation to regional and national growth, with policy objectives for: skills; building strong regions; investment in innovation; fostering enterprise and growth; and strengthening international links
<i>Science and Innovation Strategy, 2001</i>	Outlined DTI's aims, objectives and science and innovation priorities
<i>Innovation Report, 2003</i>	Outlined direct measures to be taken in seven key areas to ensure that the UK will be a "key knowledge hub in the global economy" Recommended the establishment of a Technology Strategy Board.
<i>Lambert Review, 2003</i>	Analysed the specific role of university-industry collaborations in supporting innovation
<i>Science and innovation investment framework 2004 – 2014</i>	Set qualitative attributes of a successful system to support improvements in UK innovative performance over medium to long term
<i>Business Support Solutions: A new approach to business support, 2004</i>	Defined the new approach to business support in the light of the review of DTI activities
<i>DTI: Five Year Programme: Creating Wealth from Knowledge, 2004</i>	Outlined the key challenges facing the UK economy and the role that the 'new' DTI would play in addressing these challenges
<i>Technology Strategy Board – Annual Report 2005</i>	Summarised the activities of the Board since inception in 2004 and outlined next stages of activities "to deliver a technology strategy for wealth creation and to position the UK as a global leader in innovation"

- Venture Capital Trusts (VCTs): The Enterprise Investment Scheme (EIS) was a means by which individual 'informed investors' could make investments directly into new, privately-held companies and be exempt from certain capital gains tax payments. The VCT widens the opportunities by allowing individuals to invest in a fund which then itself invests in new, privately-held companies.

¹⁹⁵ These reports can be downloaded via www.fundingtechnology.org

5.20 The government has also been keen to support universities in taking on a greater role at all stages of the innovation process, and not just to be focused on the traditional university activities of teaching and research. To that end, the government has implemented a number of university-focused programmes, examples of which have been described in Chapter 4. The current government has been able to build upon a number of platform activities developed over the last 20 years to focus new initiatives upon the increasing entrepreneurship and innovation to support higher national productivity. The direct effectiveness of these activities upon improving the UK's productivity is clearly hard to measure though data from Livesey *et al.* (2006) provides some insight onto this linkage.

5.21 The evolution of the consultations and analysis listed in Table 5.1 earlier have led the government to view innovation as one of the five main drivers of improved UK productivity; the others being skills, investment, competition and enterprise. The DTI has developed a strategy and selected five areas to focus efforts where they believe they can have the greatest impact on improving the UK's productivity:

- Transferring knowledge
- Maximising potential in the workplace
- Extending competitive markets
- Strengthening regional economies
- Fostering stronger partnerships

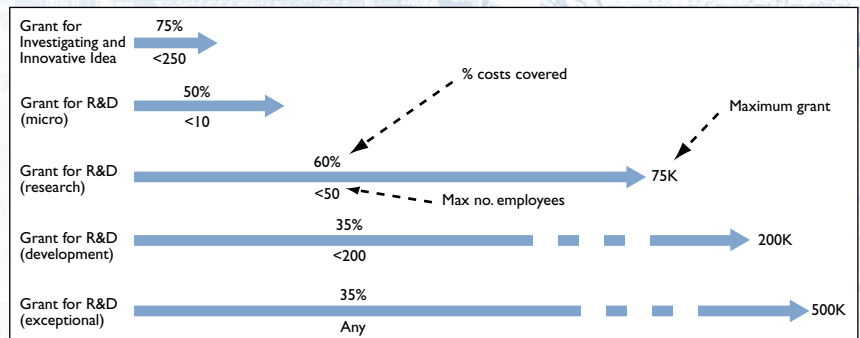
5.22 The approach taken specifically to support innovation encompasses a series of direct (e.g., awards paid directly to companies to 'do' innovation, such as Grants for R&D) and indirect support measures (e.g., fiscal measures to give incentives to companies to undertake various innovation-related activities, such as R&D Tax Credits)¹⁹⁶.

How has Government Structured its Support?

5.23 The number of schemes initiated as a result of the various policy documents outlined earlier, or which have been initiated through other activities but which are aimed at improving the productivity of UK industry under the broad headings of 'business support', had reached over 3,000 by 2005. A review of DTI business support activities in 2004¹⁹⁷ highlighted concerns at lack of coherence and clear communication of business support offerings. The DTI's response to this was to:

- make strategic investments in business support to drive up productivity;
- simplify through focus on customers and their relationships with DTI; and
- increase accessibility through improving the delivery of business support.

Figure 5-1: Grants, their limits and eligibility criteria



Source: Livesey *et al.* (2006).

5.24 One output of the review and refocusing of activities was the winding down of numerous business support schemes and the structuring of activities around customer themes. On the specific goal of improving the UK's ability to innovate, five core products were identified following the 2004 review: Knowledge Transfer Networks; Collaborative R&D; Grants for Investigating an Innovative Idea (now discontinued); Grants for R&D; and Knowledge Transfer Partnerships.

Figure 5-2: DTI's re-structured for innovation support activities as of 2005

The goal	Increased productivity			
Customer themes	Technology & innovation	Access to finance	Improving business performance	Regional investment
Product set	DTI Business Support Solutions			
	Investigating an innovative idea	Small firms loan guarantee (SFLG)	Access to best business practice	Selective finance for investment in England
	R&D grant	Enterprise capital funds (ECFs)	Support to implement best business practice	
	Collaborative R&D			
	Knowledge transfer partnerships			
	Knowledge transfer networks			

5.25 Information for firms on what practical support is available to help them innovate is now channelled through a number of sometimes overlapping online sources provided by the DTI, Business Link, HM Treasury and HM Customs and Excise. This reflects the fact that while the core offerings have been rationalised and simplified, the message to companies seeking to know more about how to innovate is still somewhat complex. It is also clear that while there are many routes to finding out about the core offerings to directly support innovation, information on the indirect sources of support will come from a wide range of sources. For example there are also additional sources of funding to support innovation available via organisations such as NESTA¹⁹⁸ and the Carbon Trust.

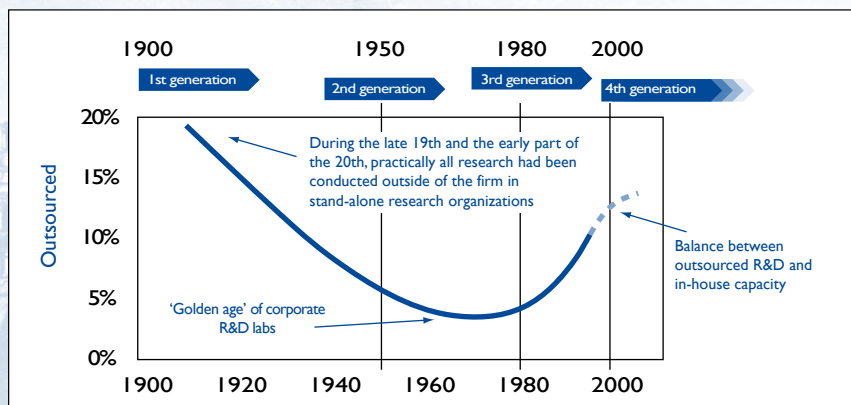
196 www.businesslink.gov.uk

197 DTI (2004a; 2004b).

198 National Endowment for Science, Technology and the Arts

– www.nesta.org.uk

Figure 5-3: An historical perspective on outsourcing R&D



Source: European Industrial Research Management Association

5.26 With the trend in many industries towards open innovation, the Government can play a useful role in supporting collaborations between firms, particularly when one firm is a resource-limited start-up and the other is a large, established firm. The smaller firm is typically in (or perceives itself to be in) a weak position when seeking to negotiate with a larger firm. Programmes such as Collaborative R&D or Knowledge Transfer Networks can place smaller firms on a more equal footing with large partners. Larger firms get access to a new source of ideas, and the small firm gets access to a wide range of complementary assets needed to bring its invention to market¹⁹⁹.

5.27 To simplify the way in which companies access the help they need, there has been a clear desire by the government to encourage firms to access support via the Business Link network, delivered at a regional level. A potentially powerful resource to link individual company need is that of the Business Link Grants and Support Directory²⁰⁰. This provides information on national and region-specific assistance available to help firms access funding and direct business support, including innovation-related activities. However, using such a system will raise many options but there needs to be intelligent interpretation of what the diverse funding schemes identified as a result of this actually mean. Users are then encouraged to contact their local Business Link to receive advice and support for accessing the funds they need.

5.28 The increasing role of the regions as the focus of public support for innovation presents both opportunities and challenges. On the plus side, innovation support can be tailored to particular regional needs. On the downside, it may lead to rationing of support to regions with higher levels of innovative activity. One regional innovation support instrument that is proving very popular is that of the

'Enterprise Hub'. Though many different definitions exist for these, most have the common characteristic of being a regionally funded collaboration around innovation and enterprise. They typically bring together a range of independent support activities around a particular theme, be it type of firm (e.g., high growth potential) or industry sector (e.g., biotech) or both.

5.29 While efforts have continued to clarify the routes for firms to access public support for innovation, there has also been a recent significant internal restructuring at the national level. The DTI's Innovation Group (IG) was merged with the Office of Science and Technology (OST) to form the Office of Science and Innovation (OSI). The OSI will concentrate on investing to develop further the UK's research base and on promoting innovation. Sir David King, is the Government's Chief Scientific Advisor and Sir Keith O'Nions is the new Director General of Science and Innovation, responsible for the work of the Research Councils and the former Innovation Group.

Summary

5.30 Government support for innovation and entrepreneurship has passed through a series of phases over the past forty years. Building upon the enterprise culture of the Thatcher era, the New Labour Government has sought to put entrepreneurship and innovation at the heart of their policies to improve the UK's productivity and innovation.

5.31 The nature of the innovation process is changing, and Government support for innovation must reflect this change. As firms move towards a more open model of innovation, (See Figure 5-3) government can play a role in supporting collaborative innovation and ensuring a 'level playing field' for small and large firms.

5.32 Government support for what it terms innovation should not ignore the difference between developing ideas (invention) and bringing them to market (innovation). Support is needed for both, and focusing much of the effort onto invention through support for R&D may not be sufficient to increase our innovative capacity and hence improved productivity.

199 For more information on research on this topic, see www.ifm.eng.cam.ac.uk/ctm/research/projects/alliances.html

200 www.businesslink.gov.uk/bdotg/action/gsd

Table 5.2: Examples of direct and indirect public support for innovation

Main title	Managed by	Broad purpose	Target companies	Amount per company	Programme budget
Grants for investigating an innovative idea	DTI	Reimbursed consultancy to help businesses get advice on the steps needed to implement their ideas. The grant will cover 75 per cent of the costs of the mentor and expert consultant, up to a ceiling of £12,000.	Businesses with fewer than 250 employees wishing to exploit an innovative idea.	<£12k	£1.2m-£1.5m for pilot year (currently on hold)
Grants for R&D (Research)	DTI/RDAs	Aim to investigate the technical and commercial feasibility of innovative technology. Up to £75k	Businesses with fewer than 50 employees.	<£75k	£100m for 2004-2007
Grants for R&D (Exceptional)	DTI/RDAs	Projects that involve a significant technological advance and are strategically important for a particular technology or industry sector. Grants of up to £500k	Any business.	<£500k	
Grants for R&D (Development)	DTI/RDAs	Aim to develop a pre-production prototype of new product or process that involves a significant technological advance. Up to £200k	Businesses with fewer than 200 employees	<£200k	
Grants for R&D (Micro)	DTI/RDAs	Simple, low cost development projects lasting no longer than 12 months. Grant of up to £20k.	Businesses with fewer than 10 employees.	<£20k	
Knowledge Transfer Partnerships	DTI	A grant to cover part of the cost of using a person to transfer and embed knowledge into a business from the UK knowledge base via a strategic project	All businesses needing expert help to innovate	Not specified	£370m for 2005-2008
Knowledge Transfer Networks	DTI	A grant to an intermediary to set up a network in a priority technology area, bringing together businesses, universities and others with an interest in technology applications	All businesses wanting to grow by exploiting technology		
Collaborative R&D	DTI	Funding for collaborative research and development projects between businesses, universities and other potential collaborators. The level of grant support will vary from between 25 per cent and 75 per cent of R&D costs	All UK-based business wishing to exploit technology		

Source: Livesey et al. (2006).

Advisers, tax and incubation

"When I was myself very young, I knew quite well the Oxford team which produced penicillin. There in Oxford is a symbol of the old university culture. Oxford produced penicillin, and the only thing that it got is a rose garden that stands in front of the Botanic Gardens given by a lady from Philadelphia in thanks giving."

(Sir) Maurice Shock, Vice Chancellor of Leicester University²⁰¹

"Incubators? Kennels for sick dogs!"

Anonymous U.S. technology transfer manager

*"In my coat of arms, I took as my motto, **Fiat justitia**- Let Justice be done – believing it to have a respectable origin. I have since discovered that it was first used to excuse the most outrageous injustice [...] Piso sentenced a soldier to death for the murder of Gaius. He ordered a centurion to execute the sentence. When the soldier was about to be executed, Gaius came forward himself alive and well. The centurion reported it to Piso. He sentenced all three to death. The soldier because he had already been sentenced. The centurion for disobeying orders. And Gaius for being the cause of the death of two innocent men. Piso excused it with the plea, **Fiat justitia, ruat coelum** – Let justice be done, though the heavens should fall."*

Lord Denning²⁰²

Introduction

- 6.1 Funding early-stage technology requires a professional infrastructure to provide the range of services that, with the finance providers themselves, ensure a flourishing capital market. Silicon Valley is famous for its infrastructure of these services, as well as active venture capitalists and links to universities and entrepreneurs. This chapter examines professional services for early-stage technology firms, the regulatory and tax frameworks, as well as business incubation, one of the more notable attempts in recent years to foster innovation.
- 6.3 But a wide range of other services is also involved. Among the BVCA's 129 professional associate members²⁰⁴ are: investigation firms, risk management advisers, insurance firms, 'human capital advisers' and strategic pay consultants, executive recruitment consultants, management consultants, publishers, research houses and communications consultants. There are also several environmental advisers in membership, indicating that technological developments impacting on the environment may be a strand in the provision of venture capital and private equity to technology businesses.

BVCA Associate Membership

- 6.2 The BVCA has developed a category of 'Associate Professional Member' to represent this infrastructure. Their membership list²⁰³ gives a good guide to the range of services and advisors that are now active in the UK. Predictably the accountancy and legal professions are well represented. The big global accountancy practices are members, as are firms serving more regional and local markets. The big City law firms are involved, as are more local legal practices.
- 6.4 It is not possible to say, on the basis of the BVCA website, what proportion of advisers' work goes into the venture capital industry and what proportion into private equity. Given the structure of the UK industry, it seems likely that advisors concentrate fairly heavily on private equity. However, a number of firms mention both venture capital and private equity
- 6.5 There have in the past been recommendations that the professional bodies should do more to encourage their members to take an interest in the financing of early-stage technology businesses.²⁰⁵ The websites

201 *Economist Intelligence Unit (1985) p91.*

202 Denning (1981) p172 (citing Seneca, Dialogues III, 18).

203 <http://www.bvca.co.uk/>; accessed on 19 November 2004.

204 Authors' own calculation on 12 November 2004.

205 Gill *et al.* (2000) p33; Pickering (2002) p35.

of the Institute of Chartered Accountants in England and Wales (ICAEW), the Association of Chartered Certified Accountants (ACCA) and the Law Society are instructive in this context.

- 6.6 We searched on all three sites for references to 'venture capital' and 'technology business'. The wide range of answers provided, often with a bias towards tax advice, suggests that all three have some way to go before they offer a satisfactory service to early-stage technology businesses. So the call in our report on the US for more activity by advisers in this sector in the UK still stands.
- 6.7 The cost of professional advice is a real issue for early-stage firms. The government has long resisted tax relief on the costs of raising equity finance, but it does seem indefensible that the costs of raising debt are fully relieved while the costs of raising equity are not. It discriminates against equity and against early-stage firms, much more reliant on equity finance and less able to raise debt than their established competitors.
- 6.8 Another idea for alleviating legal costs is to offer legal advisors equity or share options in part-payment. Originating in the US there was anecdotal evidence that this idea was taking root in the UK during the dot com boom, but we know of no evidence that it has become established. As and when equity markets revive we hope that it will be used more widely.

The Legal Framework

- 6.9 Like the previous administration, the present government has a rolling programme of company law, led by the DTI. The Company Law Reform Bill, introduced to the House of Lords on 1 November 2005 and brought forward to the House of Commons on 24 May 2006, includes a package of reforms aimed at small companies. They include plans to lighten the reporting and accounting load and simplified decision making for private companies including the removal of the requirement to have a Company Secretary. The legislation should also make it easier to set up a company. What was by then the Companies Bill completed the Commons Committee stage in July 2006 and received Royal Assent in November 2006.
- 6.10 DTI does not seem to have plans to raise further the threshold for having to publish annual accounts, which has been raised a number of times in recent years. This seems right. From a financing perspective, there is a risk that early-stage companies will be unable to provide financial data of a quality that will encourage providers of external finance to do business with them. However, the deadline for private companies to file their annual reporting documents will reduce from ten months after the year-end to nine
- 6.11 The current government has made one legislative reform in company law which is worth mentioning.

They have introduced Limited Liability Partnerships (LLPs) in The Limited Liability Partnerships Act 2000 and Regulations 2001. Both came into force on 6 April 2001. These partnerships are an alternative corporate business vehicle that gives the benefits of limited liability but allows its members the flexibility of organising their internal structure as a traditional partnership. An LLP is taxed as a partnership. The internal structure of the LLP is similar to that of a partnership. The members provide working capital and share any profits. Income derived by the members from the LLP will be closer to that of a partnership than to the dividends paid by companies.

- 6.12 A number of law firms, including some BVCA members, have taken advantage of this legislation. It looks likely to make it easier to participate in venture-related activities.

The Tax System

- 6.13 The UK tax system has long put in place a series of incentives aimed at encouraging equity investments in early-stage firms.
- 6.14 The first was in 1981, the Business Start-up Scheme, replaced in 1983 by the Business Expansion Scheme (BES). By the early nineties the latter had a poor reputation with the tax authorities. It was seen primarily (though not universally) as a tax avoidance scheme, with investors in fine wine and property qualifying at little risk to themselves.
- 6.15 So in 1994–5 the BES was replaced by two schemes: Venture Capital Trusts (VCTs) and the Enterprise Investment Scheme (EIS).

VCTs and EIS

- 6.16 VCTs aim to encourage individuals to invest in early-stage companies, in a collective investment. They are quoted vehicles, similar to investment trusts. They give a range of reliefs from income and capital gains taxes including income tax relief at 30% (increased to 40% from 20% on a temporary basis in the 2004 Budget, then reduced to its current level in the 2006 Budget) and exemption from CGT on gains that arise if the ordinary VCT shares are sold.
- 6.17 At least 70% (by value) of the VCT's investments must have been 'qualifying holdings', that is shares or securities in companies which meet the conditions of the scheme and which were issued to the company and have been held by it ever since. Qualifying companies invested in by the VCT must be independent, unquoted, not conducting a range of excluded trades, with gross assets less than £7m (until the 2004 Budget the limit was £15m) before the VCT investment and £8m (previously £16m) afterwards. The minimum

holding period for new shares in VCTs is now 5 years

- 6.18 VCTs were unusual for their time in being devised by the Treasury and Inland Revenue in close consultation with the venture capital industry, rather than being shrouded in secrecy and launched on an unsuspecting market. This ensured that in the early years they were marketed skilfully and successfully by venture capitalists.
- 6.19 The EIS, introduced in 1994, permits direct investment in an unquoted company. It provides income tax relief for new equity investment by external investors and business angels in qualifying unquoted companies, and capital gains tax exemption on disposal of shares. The EIS has similar limitations to the VCT on the kind of company that can be invested in. The limit on investment in both schemes has been raised to £200,000 in 2004 and to £400,000 in 2006.

Review of EIS and VCTs

- 6.20 We are fortunate in having a recent (2003) and thorough evaluation of the two schemes by the Cambridge consultancy PACEC, in collaboration with Professor Alan Hughes of the Centre for Business Studies at Cambridge University.²⁰⁶ On the success of the two tax incentives, findings included:
- £2.2bn has been invested under the EIS since it started; £1.4bn under VCTs (these figures will have grown since the research was done);
 - Between 52% and 87% of the finance was additional i.e. it would not have been invested in the absence of the schemes;
 - The front end income tax incentive was the most powerful inducement to invest;
 - Generally post-tax rates of return on EIS investments have compared unfavourably with comparable investments, VCT investments about the same;
 - Two-thirds of investors in the schemes would be willing to use the schemes again;
 - Nearly half EIS investee companies and 40% of VCT investee companies surveyed said that they had accessed business advice and expertise via the schemes;
 - Econometric analysis suggested that the investments had had a positive effect on investee companies' growth overall;
 - The economic rationale for the schemes was judged to be valid;
 - The schemes are associated with 'important supply-side gains'.

- 6.21 Overall both schemes were judged to be broadly effective:
- For every £1m in tax foregone on EIS, the investee companies increased their turnover by £3.3m and created 65 jobs.
 - The equivalent figures for VCTs were £0.6m

and 9 jobs, though VCTs were judged to be more cost effective than EIS in terms of tax foregone per £ invested.

- 6.22 Findings on the impact of the schemes on financing technology businesses and R&D more generally included:
- 12% of companies used EIS to finance R&D, 11% of companies using VCT (second only, though by a long way, to working capital);
 - And that was the main purpose for 6% of EIS companies, 5% of VCT companies (second again).
- 6.23 Unsurprisingly high-tech companies were more likely to use these schemes to finance R&D than conventional schemes (a nice example of a scheme favouring high-tech without having any overt bias):
- High-tech companies were no more likely to seek alternative finance before issuing EIS shares but less likely to have sought a bank loan and more likely to have sought a government grant or business angel finance, if they did seek alternative finance;
 - They were however more likely to have sought additional finance after issuing EIS shares; and, where they had done so, were less likely to have sought a bank loan, but more likely to have sought other venture finance (including through the VCT scheme);
 - They were also more likely to say that they would definitely or probably have taken other actions to achieve the same effects as they achieved through the EIS scheme, if they were unable to use it;
 - They were no more likely to seek alternative finance before issuing VCT shares, but less likely to have sought a bank loan, if they did seek alternative finance;
 - For EIS, the biggest sector supported in 1999/2000 was high-tech companies, accounting for 28% of funds invested (having grown significantly);
 - For VCTs, up to 1998/9 over 40% of investment was in 'industrial products and services' (a rather broad category based on PWC data). About 30% was 'high tech'.
- 6.24 Overall the two schemes seem to have been broadly successful in achieving the objective of encouraging additional finance in the early-stage sector, with a particular benefit for high-tech firms.
- 6.25 The capital gains tax (CGT) regime has also been adapted over the years. With a 10% marginal rate for business assets held for more than five years, UK CGT is now more competitive for investors than its US counterpart, probably uniquely in the developed world. It is much criticised, however, for the complexity of the regime, so some further simplification would be welcome.

206 Boyns et al. (2003).

Encouraging R&D

- 6.26 It has long been argued that the UK needs to spend more on public and business R&D to improve our productivity performance. To help achieve this aim, R&D tax credits for companies that are small- or medium-sized enterprises were introduced in Finance Act 2000. But large businesses and their representatives argued that they too should be given a greater incentive to invest in R&D, so similar credits for large companies, and a targeted relief aimed at R&D into vaccines and medicines for the killer diseases of the developing world, were introduced in Finance Act 2002.
- 6.27 The definition of qualifying costs was widened in 2003 and the definition of R&D simplified, after complaints that the initial provisions were proving difficult to get past tax inspectors. These give companies additional tax relief for expenditure on R&D, beyond what they would be entitled to under the general principles of the tax system.

Current Taxation Issues

- 6.28 All in all, the UK tax system now has an impressive array of measures that aim at encouraging individual investment in new and early-stage companies, including technology companies, and in R&D.
- 6.29 Thus the debate on tax incentives for investment in technology businesses tends nowadays to focus on targeted measures, such as the proposal that VCT investments should not be taken into account in calculating the liability for inheritance tax or proposals to revitalise the moribund incentive for corporate venturing or add-ons to the R&D tax credit.²⁰⁷
- 6.30 The Chancellor promised in his 2004 Pre-Budget Report to fix a problem discouraging university spin-outs, accidentally created by his 2003 Finance Act. This was done by legislation, effective from 2 December 2004, which prevented Income Tax and National Insurance contributions arising on researchers on an increase in the value of the shares in the spin-out company due to the transfer of IP covered by the research institution's intellectual property-sharing policy.
- 6.31 Perhaps the biggest remaining tax issue is whether the behaviour of financial institutions in early-stage investments can be influenced for the good via the tax system. Could UK pension funds and insurance companies take a more long-term view of the early-stage technology sector, with positive financial results, if given a tax incentive to do so? This idea was first put forward by a group chaired by Sir Peter Williams in a report to the Chancellor in 1998 and

was recently revived in a report by another group chaired by Sir Peter in April 2004.²⁰⁸ Sir Peter's group has also examined the relationship between science, engineering and technology sectors and the City (announced by Lord May at the Royal Society on 28 November 2004 and now available as a report from www.etchb.co.uk).

- 6.32 Recent BVCA statistics²⁰⁹ show that there are important issues here. US pension funds were the main source of UK venture capital and private equity funds in 2003: 68% of funds raised came from overseas institutions in 2003, the bulk from the US. Funding from UK pension funds remained steady at around £800m, while UK banks and insurance companies reduced their funding sharply compared with 2002.

Incubators

- 6.33 Like many ideas aimed at improving UK performance of early-stage companies, the concept of an incubator probably came from the United States²¹⁰. They are certainly more common there than in any other economy.
- 6.34 The concept has spread around the world. The UK Business Incubation (UKBI) library, for example, lists articles on incubators in Germany, Israel and Brazil, among other places.²¹¹ They are now to be found in many places: the National University of Singapore has one, for example.²¹² A United Nations Study lists 14 countries (not including the UK) with incubators, stretching from Karlsruhe to Tashkent.²¹³
- 6.35 There is room for debate around the edges, and many different ways of organising an incubator, but their central feature is that they provide a range of services aimed at fostering the growth of early-stage enterprises, usually including a small office/manufacturing and/or laboratory space. Though the development of 'virtual incubators' providing internet-based services might remove that last feature in some cases.²¹⁴ It is their clients' growth rate, therefore, which is their principal performance measure rather than say, rent per square metre, as in a managed workspace operation. They are often called innovation centres, emphasising their attractiveness to early-stage technology businesses. There are overlaps with the science park movement, though mentoring has come more to the forefront as incubators have developed.

208 HM Treasury (1998) and ETB (2004).

209 www.bvca.co.uk

210 Gill, et al. (2000) Chapter 6.

211 <http://www.ukbi.co.uk/?sid=116&pgid=119&spgid=&pn=12&s>, accessed on 5 November 2004

212 http://www.nus.edu.sg/nvs/incubator/about/incubator_incubation.html, accessed on 9 December 2004

213 United Nations (2001).

214 Ibid. p3.

207 See ETB (2004); DTI/BIA/DoH (2003).

- 3.36 Exit is also important. Incubators do not aspire to become the Microsoft campus of their own town or region, though they do aspire to help those who wish to become technology giants. They need a steady throughput of firms that will grow too big for the incubator's premises and move to expand elsewhere, to be replaced by newer enterprises. Some may limit a tenure at the incubator, perhaps by ramping up rent, as a means of encouraging throughput.

The UK Approach to Incubation

- 6.37 A Treasury report summarised the services incubators provide as:

“a sharing and learning environment; ready access to mentors and investors; and visibility in markets”.²¹⁵

- 6.38 These services may be provided profitably by the private sector but most UK incubators operate in the public or voluntary sectors, with the help of outside funding as well as their own revenue.
- 6.39 Incubators have existed in the UK for quite a long time. The Ministry of Technology, for example, issued a press notice on 29 November 1967 entitled ‘Industrial units to be set up at Universities’.²¹⁶
- 6.40 They were given a higher profile in the UK by a paper written by Graham Ross Russell for the Treasury (undated, but believed to have been first issued in 1997), which led to the setting up of UKBI, funded by the DTI and HSBC. The UKBI home page describes its remit: “As business incubation environments mature, UKBI has a key role in creating and maintaining the national network hub for the exchange and development of learning amongst its many communities of interest, including those responsible for developing incubation overseas.”²¹⁷
- 6.41 There are now over 300²¹⁸ incubators in the UK, providing a wide range of services and business environments. Around 60% of the UK's business incubation projects specialise in technology or knowledge-based companies.²¹⁹

215 HM Treasury (1999b).

216 Andrews (1973).

217 See <http://www.ukbi.co.uk/>, accessed on 18 June 2006

218 See <http://www.ukbi.co.uk/index.asp?PID=368>, accessed on 18 June 2006

219 SBS (2002) p25.

Types of Incubator

- 6.42 A study of encouraging enterprise in Oxfordshire quoted the Oxford Trust, an early and successful example of a UK incubator, on the range of subjects incubator services could cover:

“innovation and entrepreneurship, intellectual property and technology transfer, informal and formal risk capital, fiscal incentives, and regulatory matters, culture, education and training, mentoring, management capability, and many others”.²²⁰

- 6.43 To illustrate the variety of incubators, the Oxford Trust may be contrasted with the Fabriam Centre in North Tyneside.
- 6.44 The Oxford Trust began its work, as its name suggests, in Oxford, in one of the most prosperous parts of the UK. Its activities go beyond incubators though we will focus on these here. It is well placed to capitalise on the commercial potential of the research done at local universities. Starting in 1985, it built up a series of ‘innovation centres’ providing incubator services. They now exist around Southern and Western England, from Portsmouth to Gloucestershire, including one centre in London, with the bulk of activity still concentrated in Oxfordshire. In 2003 these centres housed over 220 companies, with technology businesses well represented.²²¹
- 6.45 Whereas the Oxford Trust is providing incubator services on a general basis, the Fabriam Centre is operating in a niche market. It seeks to attract established Norwegian high-technology firms to invest in the North East of England. This area suffered for decades from the decline of its traditional industry. The arrival of Nissan in the early 1980s began a process of changing the basis of the regional economy, with some success, though unemployment remains relatively high for England. The Fabriam Centre was set up by the North of England Microelectronics Institute (NEMI) and microchip manufacturer Atmel with support from One NorthEast, the TyneWear Partnership and European Regional Development Funds. The Centre scored its first success in February 2004 when Oslo-based software firm Fronter took up premises in the Centre.²²² Software integration specialist Alliance followed in July 2004.²²³

220 Lawton Smith (2003) p69.

221 Ibid. pp68–70.

222 See http://www.onenortheast.co.uk/page/newscentre/index.cfm?conews_sitesearch=1&conews_articleid=679#679, accessed on 12 November 2004.

223 See http://www.onenortheast.co.uk/page/newscentre/index.cfm?conews_sitesearch=1&conews_articleid=824, accessed on 12 November 2004.

Incubator Services

- 6.46 One interesting piece of research done for the DTI by UKBI suggests that the incubator movement is meeting the growth benchmark.²²⁴ It found that tenants and graduates of incubators grew and changed. In particular they exhibited significant increases in turnover. The tenants and graduates themselves believed that being in an incubator had contributed to their growth. The services provided, such as common facilities for providing reception, helped, as did the prestige address offered by the incubator. The precise mix of services that helped varied quite widely, depending on the firm's activities and stage of development.
- 6.47 Interestingly the provision of management support services was regarded with mixed views. In general tenants and graduates rated it as slightly more important than both the address and the premises-related services, but business support services were not frequently used, and ratings of their usefulness were moderate. UKBI thought that there was a likely relationship between type of firm, stage of development and service take-up. Most importantly, fast/high growth firms were less likely to use support services than slower growth firms. This research raises interesting questions for policy on helping incubators, but also for financing business support services more generally, not least through the Regional Development Agencies.
- 6.48 On a related point, UKBI believed that the extent and nature of the involvement of incubator managers with tenants may have a bearing on incubator outcomes; but the picture was mixed because some had less contact with tenants than did their management colleagues; different styles of involvement may have different effects, and managers have more significance for some types of firm than for others. UKBI do not comment on whether technology businesses are more or less impacted by manager involvement. On the face of it, understanding technology may inhibit the manager's involvement in product development, marketing etc. But the firm's expertise in technology may not be matched by other skills e.g., finance and sales, so managers may have a contribution here. Some research would be useful to shed light on this facet.
- 6.49 Further research would also be useful on the specific effect of selection policies on the outcomes of different incubators, where UKBI found the available evidence unclear; and on tenant exit policies, where UKBI thought the limits on tenancies might deter some entrants which might otherwise benefit.
- 6.50 Co-location was not significant to the development of tenants and graduates, and there were few linkages/trading relations between them. This seems unsurprising, given that incubators typically contain a

relatively small number of local businesses, which will frequently aspire to service markets much further afield.

Government Incubation Policy

- 6.51 DTI did not mention incubators in its list of achievements since 2003 in its 'business plan'.²²⁵ Nor do they get a mention elsewhere in the document. This suggests that after a brief period of attention after UKBI was set up, they may be dropping below a horizon nowadays increasingly dominated by delivery through Regional Development Agencies.
- 6.52 Yet over recent years DTI has provided significant funding to business incubators, though tracking the expenditure is difficult. The DTI accounts do not provide this level of detail. There was the start-up funding for the UKBI under the previous administration. The 1997 Pre-Budget Report noted, without mentioning the money involved:
- “the Government is supporting the business incubators movement, which provides start-up help for small firms working in high-technology areas: the President of the Board of Trade announced challenge funding in May for the Centre for Business Incubation Policy.”²²⁶
- 6.53 The 1999 Pre-Budget Report announced:
- “To help stimulate better delivery of such services, particularly through locally-rooted partnerships between the public and private sectors, the Government will be taking forward a £30 million programme to promote better access to finance and business support, including a new development fund to promote innovative ways of supporting enterprise in deprived areas, such as business incubator units”²²⁷
- 6.54 In the late 1990s the DTI ran the Biotechnology Mentoring and Incubator (BMI) Challenge. The Challenge was supported by a fund of up to £4.9m. According to DTI it supported 13 projects around the UK, which have assisted over 100 biotechnology start-up companies, creating in the region of 750 jobs and have raised in excess of £250m.²²⁸
- 6.55 A 2001 White Paper announced a new £75m Incubator Fund operated by the Small Business Service (though puzzlingly the Fund no longer seems to be mentioned on the SBS website). In the 2002 Pre-Budget Report the Chancellor announced new grants of up to £30,000 from the Business Incubation Fund to cover the costs of feasibility studies for incubators, with higher levels

²²⁵ See DTI (2004b).

²²⁶ HM Treasury (1997).

²²⁷ HM Treasury (1999).

²²⁸ See <http://www.dti.gov.uk/bmi/intro.htm>, accessed on 18 June 2006.

²²⁴ Small Firms Enterprise Development Initiative (2003).

of funding in disadvantaged areas.²²⁹ The SBS has provided nearly £0.5m for incubator feasibility studies under this scheme.²³⁰

Benchmarking Incubators

6.56 Encouraged by the UK Government's successive bodies looking after small business policy, the UKBI has developed a benchmarking service. They make the fair point that because of the wide variety of incubators no single set of benchmarks will fit all. And nor is every incubator activity quantifiable: a friendly chat between a manager and a lonely entrepreneur may save a business, but how to express that in numbers? The joint paper they produced with the SBS looks a useful aid.²³¹

6.57 But it would be helpful to see more of the fruits of their benchmarking work publicly available, on the UKBI website and elsewhere where appropriate. It would help the incubator movement, government and others with an interest to know more about how the movement is developing and how effective it is as a help to growing business, not least technology businesses. Looking at the corporate plan of One NorthEast, the North East RDA, for example, there are brief allusions to individual incubators and business parks, but the subject is not singled out as a focus with performance measures.²³²

6.58 Such work would also be useful to convince the sceptics. A recent article in *The Scientist* for example quotes Ray Oakey of the Manchester Business School: "My basic view is that incubators are not all that important," he says, adding that venture capital companies also have to do a better job of vetting companies. "The important thing is to get the funding to the firms that are most deserving of it. The general evidence is that that's not happening."²³³

6.59 Certainly the need for incubators in individual areas should not be accepted uncritically. There may be too many players vying to offer incubator space in Wales for example.

Incubation in the EU

6.60 There is a growing interest in incubators in the EU. A List of European Commission case studies published

229 See http://www.hm-treasury.gov.uk/Pre_Budget_Report/prebud_pbr02/press_notices/prebud_pbr02_pressrevhmtcel.cfm, accessed on 19 November 2004.

230 E-mail from Frank D'Cruze (Small Business Service) to Craig Pickering on 22 November 2004; see also press notice by Minister for Small Business on 9 August 2004.

231 Small Firms Enterprise Development Initiative (2003).

232 See <http://www.onenortheast.co.uk/page/aboutone/rap.cfm>, accessed on 12 November 2004

233 Brahic (2004).

in 2002 provides information on incubators in 12 member states.²³⁴ They give data on value for money. Looking at the UK example, the Commission says:

"Project North East has succeeded in ensuring that its workspace operations are more or less financially self-sustaining with rental incomes covering running costs. Moreover, having purchased disused premises at below market rates it stands to make a considerable return on its investments and hopes to pay off debts in 4-5 years. As Pink Lane has improved from a red light district to an up and coming location, property values have risen considerably."

6.61 The Enterprise and Industry Directorate General (one of 17 policy themed Directorates General of the European Commission) created in 2002 a new database to provide an overview of some 950 business incubators in the then 15 Member States, Norway, Iceland, Liechtenstein, Switzerland and the 13 countries applying for EU membership.²³⁵ Another 2002 document by the Commission²³⁶ claimed:

"90% of all start-ups set up inside a business incubator are still active three years later. The public cost of creating jobs inside incubators is €4,000, which is very low compared with other public means and programmes. The 850 European business incubators assist in creating 29,000 new sustainable jobs every year in enterprises, that are much more viable than enterprises set up outside incubators."

6.62 However, such statistics need to be viewed in terms of the validity of the underlying research. For example, how many of these incubator-based jobs would have been created anyway? To what extent do incubators simply 'cherry-pick' the best companies?

Summary

6.63 Incubation has grown at a remarkable rate since the first major study carried out on the subject by the Enterprise Panel in the 1990s and in some geographical areas there may soon be too many incubators for the current size of the market. However incubation in the UK as in Israel has been a critical component in enabling new ideas to come to market and in selecting and training entrepreneurs. Given this success, it is now reasonable for government to cut back on its tangible support while maintaining strong moral support and continuing to provide signposting to and information on incubation.

234 European Commission Enterprise Directorate-General (2002a).

235 <http://ec.europa.eu/enterprise/bi/index.htm>

236 European Commission Enterprise Directorate-General (2002b).

Incubation and manufacturing: does size matter?

Does size matter? While an economy consisting mainly of smaller, dynamic research companies may appear to be the paradigm of the 'new economy'—clean, knowledge-intensive, growth oriented, with high-value added—small companies on their own may be insufficient even for a high-value manufacturing base:

"the UK has so far generated very few large, nationally owned electronics firms. How much does this matter? American entrepreneurs, in Silicon Valley and elsewhere, have undoubtedly benefited from the presence of larger firms, most of which had been small start-ups themselves some twenty years earlier. They are valuable as role models, as customers for the new entrants' products and as a source of experienced management. According to Gordon Moore, co-founder of Intel, successful start-ups almost always begin with an idea that ripened in the research organisation of a large company. 'Lose the large companies or the research organisations of large companies, and start-ups disappear.'" ^I

The other side of the case, relying on 'brains rather than brawn' has been well put by Sir Richard Sykes, Rector of Imperial College and former Chairman of GlaxoSmithKline:

"We have to use our brains. We can't compete against the Indians and the Chinese in terms of manpower, but we can compete in areas in which we have great strengths. We're good at high-end engineering ... Formula 1 cars, world-class hi-fi ... and we're very strong in biosciences." ^{II}

However, the role of larger corporates is as important for the innovation process in 'clean' sectors as it is for 'traditional' manufacturing reliant on significant material inputs. Britain still has a competitive advantage in biotechnology and pharmaceuticals:

"Barriers to entry were lower in biotechnology than they had been in semiconductors, and UK biotechnology firms had an advantage which was not shared by comparable start-ups in electronics – the presence in the UK of a large and successful pharmaceutical industry, including British-owned firms such as Glaxo, Beecham and Wellcome as well as foreign-owned firms such as Pfizer which had built research and manufacturing facilities in the UK. While these 'Big Pharma' companies did not necessarily favour UK-based biotechnology firms when considering licensing deals and other forms of cooperation, they provided a valuable source of technical and managerial talent." ^{III}

And the UK's current competitive advantage may not be sustainable, partly because of the sheer scale of financial resources required to sustain drug discovery, and partly because of the regulatory constraints and activist intervention operating in the UK and the potentially-promising European market:

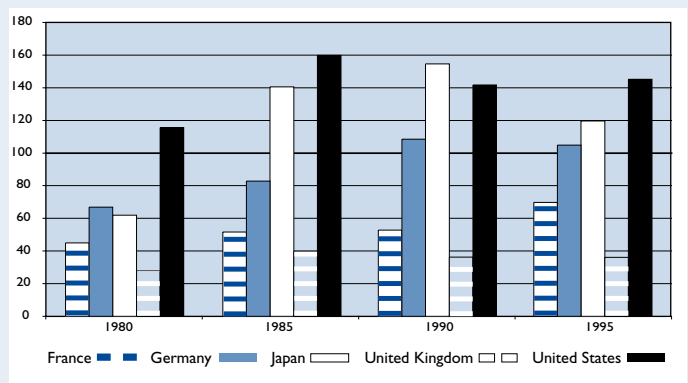
"The animal rights issue is deterring inward investors. Europe's socialised healthcare systems – including the NHS – mean that in each country the drugs companies have only one significant customer, demanding the lowest possible price. America's free-market pricing system makes investment in drugs R&D much more attractive [...] To take a major medical innovation from the test tube via the animal laboratory to human trials, 'proof of concept', regulatory approval and commercialisation, can be a 15-year, £500 million proposition." ^{IV}

Of similar concern to investors and policy makers alike is the continuing weakness in the UK's 'innovation index', which may come as a surprise given the steady growth of positive factors over recent years such as incubation and private equity. As the Institute for Manufacturing noted in a recent review for the Design Council:

"The Council on Competitiveness in the United States released a report in 1999 which developed a national index for 'innovative capacity'. The approach taken was to measure "... the ability of a country to produce a stream of commercially relevant innovations." The index included measures such as the number of people engaged in R&D, investment in R&D, and the strength of intellectual property protection. To make country comparisons, the index was scaled for population and calculated for 17 OECD countries from 1973 to 1995."

"According to this index, over the past twenty years the UK has consistently under performed against all other large economies, other than Italy. Also, while some high performing nations have converged, the UK remains well below the level of the US and Japan up to 1995. The graph [in figure 6.1] shows the results for the UK and the main comparator nations and we can see that the gap in innovative capacity has remained essentially stable or widened to all of these countries between 1980 and 1995." ^V

Figure 6-1: Innovative Capacity index (selected years)



It should be noted that these data stop in 1995 and the mid-1990s were arguably an inflexion point for the UK in terms of changes in attitudes to entrepreneurship, increase in venture investment and the impact of 15 years of government policy favouring business creation. Such trends have continued in the intervening decade and later data *may* show a material improvement in the UK's comparative position. Furthermore, the index tracks inputs rather than outcomes ("number of people engaged in R&D, investment in R&D, and the strength of intellectual property protection") and the UK has consistently shown an above-average efficiency in deriving tangible results from limited investment. However, it is unlikely that the UK can continue to prosper without addressing investment in the input factors of the knowledge economy.

I Owen (2004) p28, citing Gordon E. Moore *Some personal reflections on research in the semiconductor industry* in Rosenbloom and Spencer (1996).

II Vander Weyer (2006).

III Owen (2004) pp32–33.

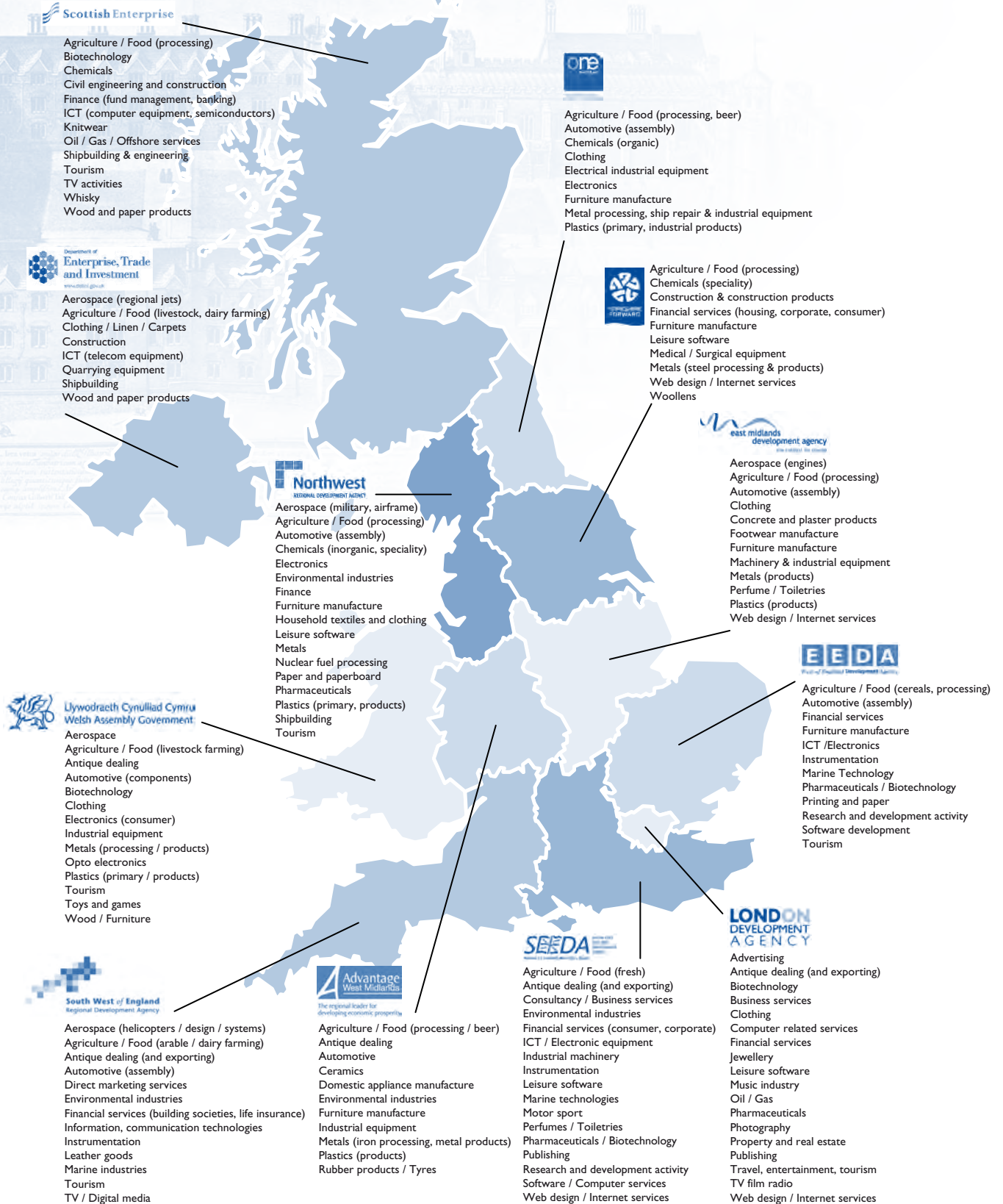
IV Vander Weyer (2006).

V Livesey *et al.* (2006).



Annex A:

Regional Development Agency Map Showing Major Clusters



Source: Adapted from Department of Trade and Industry (2001), Business Clusters in the UK - A First Assessment, www.dti.gov.uk/regional/clusters/clusters-assessment/page17380.html

Annex B: Government Spending Plans 2004–2008¹

The 2004 Spending Review takes further steps to strengthen the UK economy, to increase productivity and employment and to promote sustainable and balanced growth. In particular, this Spending Review:

- sets a ten year ambition to increase the ratio of UK R&D spending to national GDP from the current level of around 1.9 per cent to 2.5 per cent, with science spending through DfES and DTI over £1 billion higher in 2007-08 than in 2004-05, an annual average growth rate of 5.8 per cent in real terms;
- significantly increases spending on education and skills, with education spending in England set to be £12 billion higher in 2007-08 than in 2004-05 and per pupil funding rising to at least £5,500 by 2007-08, more than double the 1997 figure;
- provides additional resources for housing, with spending on housing over £1 billion a year higher in 2007-08 than in 2004-05, delivering a 50 per cent increase in new social house building an additional 10,000 homes a year and funding through the Sustainable Communities Plan to deliver 200,000 additional homes in the Thames Gateway and other growth areas;
- builds on the significant investment in transport in the 2002 Spending Review, with spending on transport £2.4 billion higher in 2007-08 than in 2004-05, an average annual rate of 4.5 per cent in real terms over the 2004 Spending Review period;
- takes forward the Government's commitment to balanced growth across the UK, with additional resources and responsibilities for the Regional Development Agencies (RDAs) to support small business, invest in skills, improve business-university links and promote economic development and regeneration in the regions; and
- demonstrates how the principles of sustainable development are being integrated into decision-making and spending priorities.

Department of Trade and Industry

The Government is committed to building and maintaining a world-class science base and encouraging innovation and entrepreneurship, in order to generate higher levels of sustainable productivity growth in a modern economy. As a result of this Spending Review, total spending by the Department of Trade and Industry (DTI) will be over £850 million higher in 2007-08 than in 2004-05, representing an average real growth rate of 3 per cent a year. This will deliver:

- key pillars of the ten-year framework for science and innovation, with the DTI science budget growing by an average 5.6 per cent a year in real terms over the 2004 Spending Review period. This will maintain and build on the UK's excellent science

base, with more funding for research projects, skills and capital, to equip it better to underpin innovation in UK business and public services;

- increased support for innovation, ensuring business draws on technology from the science base, through collaborative research and development (R&D) between business and universities, and knowledge transfer networks across the UK;
 - substantially increased resources and responsibilities for the Regional Development Agencies (RDAs) to provide an integrated approach to economic development, business support and knowledge transfer at the regional level; and
 - safe, cost-effective treatment of the UK's historic nuclear liabilities with the establishment of the Nuclear Decommissioning Authority (NDA) from April 2005.
- Key reforms that DTI will undertake over the 2004 Spending Review period include:
- implementing the Technology Strategy to lead improvements in business innovation with funding of at least £178 million a year by 2007-08 for collaborative R&D and knowledge transfer networks;
 - regional delivery of a wider array of support for business and enterprise, through devolution to the RDAs of the Business Links service, R&D grant and some enterprise for disadvantaged communities funding;
 - continuing reforms to UK Trade and Investment focusing on encouraging inward investment into the UK as well as export promotion and better capability at regional level to provide UKTI services to UK businesses, particularly firms who are new to export; and
 - further reform, building on DTI's recent strategic reviews of its organisation and business support, to refocus resources towards top priority programmes and away from lower value business support and administration.

Regions and devolved administrations

The Government's long-term aspiration is to reduce the persistent economic disparities between UK regions. The Government believes that the best way to overcome regional disparities in productivity and employment rates is to provide each nation and region the freedom, flexibility and funding to exploit indigenous sources of growth. The principles underlying the Government's approach to regional economic policy were set out in the Devolving Decision Making Review. To enhance the capacity of the regional institutional framework to deliver improved economic outcomes, the 2004 Spending Review:

- maintains funding for Regional Development Agencies (RDAs) in real terms and devolves new responsibilities to the RDAs from departments with a transfer of around £200 million a year from 2005-06. These transfers will increase the size of the Single Pot by

¹ Summaries taken from HM Treasury (2004).



- 10 per cent from 2005-06 compared to 2004-05;
- announces devolution to the RDAs of responsibility for delivery of Business Link services; and
- announces new responsibilities for the RDAs in managing research and development grants, promoting enterprise in disadvantaged areas, delivering on rural priorities and encouraging collaborative research between business and universities.
- In Scotland, Wales and Northern Ireland, responsibility for economic development and public services is, to a large extent, devolved. The 2004 Spending Review provides a major boost to public services and economic development in Scotland, Wales and Northern Ireland. Resources for public services and economic development in 2007-08 compared to 2004-05 will be:
 - £4.2 billion higher in Scotland;
 - £2.5 billion higher in Wales, including increased resources for Wales
 - European Structural Funds programme; and
 - £1.2 billion higher in Northern Ireland.
- capital investment in education will rise from £0.8 billion a year in 1997-98, £5 billion in 2004-05, to £7 billion a year in 2007-08; and
- efficiency gains worth at least 2.5 per cent of the Department for Education and Skills' (DfES) 2004-05 baseline will be made each year over the Spending Review period, releasing additional resources for the front line.
- This investment will support reforms in the following key areas:
 - deliver the Five Year Strategy for Children and Learners¹
 - establish 2,500 Children's Centres by 2008, going beyond the Government's commitment to a children's centre in each of the 20 per cent most disadvantaged wards in England and on the way towards achieving the goal of a Children's Centre in every community;
 - increase average per pupil funding to at least £5,500 by 2007-08; more than double the 1997 figure;
 - designate universal specialist schools, alongside up to 200 academies, by 2010. All secondary school buildings will be transformed to twenty-first century standards in the next 10 to 15 years and more schools across the country will be able to offer extended services;
 - maintain the levels of real terms student funding per head and continue to advance progress towards the Government target to increase participation in higher education towards 50 per cent of 18 to 30 year olds by 2010;
 - deliver the New Deal for skills to help those with no or low qualifications into work and then to help improve their prospects by acquiring skills; and
 - deliver challenging new PSA targets to increase the proportion of 19 year olds achieving at least level 2 and reduce the proportion of young people not in education, employment or training.

Department for Education and Skills

The Government's aim is to achieve excellence in standards of education and levels of skills, and to give everyone the opportunity to develop their learning and realise their potential. The 2004 Spending Review delivers significant additional resources in support of this aim. In particular:

- total spending on education in England will be £12 billion higher in 2007-08 than in 2004-05, an average growth rate of 4.4 per cent per year in real terms over this period;
- education spending will rise to 5.6 per cent of GDP by 2007-08 from 5.4 per cent in 2004-05;



Annex C:

Brunel / York Scoring Protocol

IT/Engineering		Bioscience
How well will it work?		
1	Idea only, little evidence of practicality or manufacturability	No evidence of validation
3	Prototype exists - principles established - internal evaluation only	Some evidence of functionality of technology, drug compound or bioactive agent
5	Manufacturing preparations well advanced but no customers yet	Successful Phase I Clinical Trials completed
7	Recently launched - early reports from customers good	Successful Phase II Clinical Trials completed or applications submitted to regulatory authority
9		Successful Phase III Clinical Trials or full approval by regulatory authority
10	Established product/technology - already satisfied customers - good order book	
Unique selling proposition (USP)		
1	No innovation - other factors contribute to viability	
3	Some distinct improvements over existing products	
5	Innovative but could be difficult to convert customers	Significant improvements over established technologies
7	Obviously innovative and easily appreciated advantages to customers	
10	Very innovative and satisfies a well known market need	Completely new drug target or new biotechnological approach
How does it satisfy a market sector?		
1	No specific market sector has yet been identified	
3	Market potential identified but not quantified	
5	Market sector defined with some customer feedback	
7	Clear market demand and possible to demonstrate some customer satisfaction with product	Responding to legislative and regulatory pressures
10	Strong demand from a well-defined sector of the market. The product can be demonstrated to meet the requirements of customers fully	
Timeliness		
1	(a) Product anticipates a demand but customers are not yet buying such products since they are not aware of availability of benefits. (b) The market is already supplied with many products of the type proposed and shows signs of saturation or decline	
3	(a) Some customers are seeking and purchasing such products but an expanding customer base is not yet proven. (Highly specialised interest area at present). (b) There are alternative established products and establishing a new product may be difficult. Not strongly differentiated from existing products	
5	Some discernible activity in the area of the innovation indicating potential but the evidence is not yet firm	Demand is driven by new regulations and legislation although strength of the customer base is not clear
7	Definite growth in the area of the innovation which will support establishment of a new product	
10	Recent developments/innovations which support the product show strong growth curves. The product fits closely in this scenario and would be expected to benefit from this growth	New regulations and legislation creating urgent demand
Longevity of product line?		
1	Only one purchase per customer likely for the product. Could be a fashion or a fad for a limited time period	
5	The market for the product exists but not necessarily firm. Demand may be variable. Success depends on whether this market becomes more stable	Strong patent position but with competitors for same targets
10	Similar products satisfying this market sector have been established for a period of years and will definitely be required for the foreseeable future. Once established the product may lead to repeat purchases	Pharmaceuticals with strong patent position and no strong competitors for the same targets
Does it fit into a family of products to permit company establishment/development?		
1	Product is a single member of what would normally be regarded as a product group. Would need complementary products to gain a foothold in the market but not viable as a single item	Single product and single purchase
5	Viability as a single product is questionable. Difficult to see how modest profits could lead to successful business growth	Number of related products identified
7		A number of related products in the development phase
10	A viable business can be built on a single product initially. Further added value, complementary items envisaged for future growth. Other members of the product family exist	Multiple products in different phases of development
Previous technical innovation		
1	No previous successful product. Background of applicant(s) does not provide confidence that their knowledge is state-of-the-art	
5	Some evidence of successful innovation but not necessarily a financial success. Applicant(s) provide some confidence that technical expertise exists	
10	Strong record of innovation from more than one product – as business venture or as part of a larger organisation (spin-off). Applicant(s) very knowledgeable about the area of development	
Intellectual property rights		
1	No patent possible (e.g. published information). None proposed. Unpatentable.	
3	Provisional patent only. Patent possible (unpublished). Limited coverage.	
5	Full patents applied but not yet granted. Coverage in appropriate market areas.	
7	Apparently strong patent position although be contested by identifiable major player.	
10	Full patents granted with good coverage. Possible successful prosecutions for infringement.	



Proposal rating

Example	Score	Weighting	Product
Will it work/how well?	5	3	15
USP (How innovative?)	5	2	10
Competitive advantage	5	1	5
Timeliness	5	1	5
Longevity/repeat orders	5	0.5	2.5
Family of products	5	0.5	2.5
Previous record	5	1	5
IPR	5	1	5
Total	40	Sum	50
		Scaled product	39

As an approximate guide, a score of 50+ for the sum and 100+ for the scaled product indicates that the technical merit to consider funding.

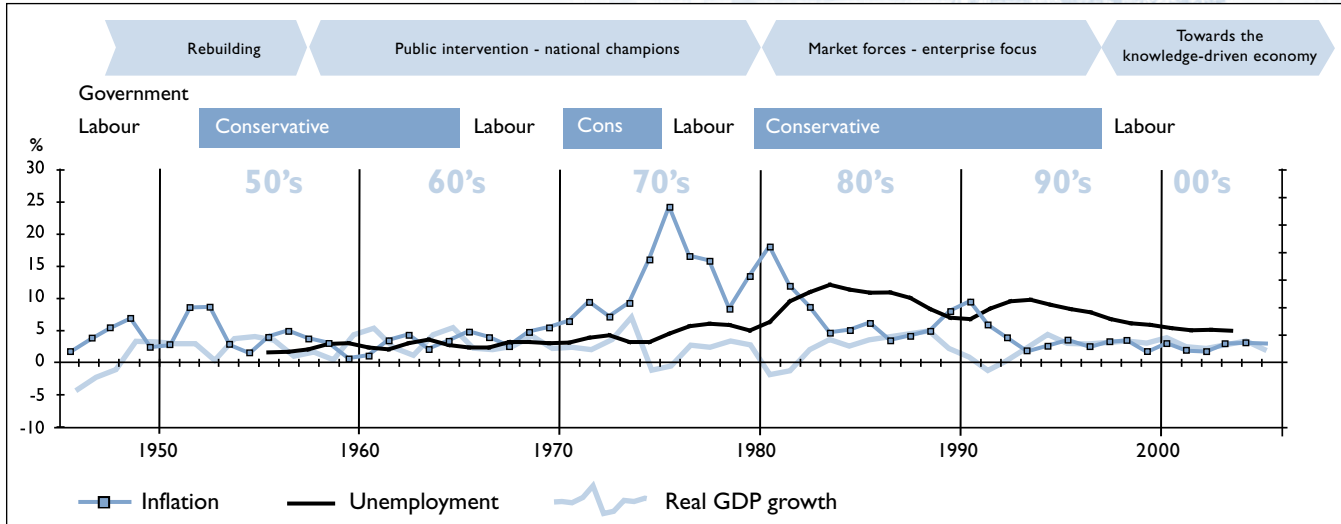
Multiplying the weighted scores together and dividing the result by 15,000 determines the scaled product. Its purpose is to indicate whether there are weakness areas. Low scores in any category will have a more substantial effect on the final score than the simple sum. In many cases, early attention to the low scoring categories will strengthen the proposal significantly.

Business plans based on information technology (usually software or internet-based) usually score low under the IPR category. Patents are difficult to acquire and copyright does not prevent competitors developing similar products from a functional point of view. For such companies, a score of 46+ for the sum could be considered acceptable for the consideration of funding. Similarly, the scaled product is affected—a score of 20+ is acceptable in this case. Since such companies are vulnerable to competition, issues of service quality, marketing and branding become particularly important.



Annex D:

UK Governments & Economic Performance 1945–2005



Data sources: Adapted from: Lindsay, C. (2003). *A century of labour market change: 1900 to 2000*. *Labour Market Trends* March 2003: 133-144; Officer, Lawrence H. (2006), *The Annual Real and Nominal GDP for the United Kingdom, 1086 - 2005*. *Economic History Services*, September 2006, URL : <http://eh.net/hmit/ukgdp/>; and Office of National Statistics, www.statistics.gov.uk.



Appendix I:

Interviewees and Commentators

We are extremely grateful to the following individuals¹ who gave their time either to be interviewed or to provide comment on drafts of this document. Where cited in the text, the views expressed by these individuals do not necessarily reflect the views of the organisation with which they have an affiliation.

Stephen Allott – *Trinamo Ltd*
 Mark Aspinall – *East of England Development Agency*
 Dr George Blumberg – *Oxford Innovation Ltd*
 Professor Clive Butler – *Brunel University*
 Andy Button – *HSBC*
 Dr Victor Christou – *Oxford Capital Partners*
 Dr David Cleevely – *Analysys*
 Charles Cotton – *Library House*
 Dr Armand D'Angour – *Jesus College, Oxford*
 Tim Davies – *London South Bank University*
 Rory Earley – *Small Business Service*
 Prof Gordon Edge – *Generics Group AG*
 Howard Flint – *LINC Scotland*
 Bernard G Frieder – *Office of the e-Envoy, Cabinet Office*
 David Gammon – *Library House, Cambridge*
 Dr Elizabeth Garnsey – *University of Cambridge Centre for Technology Management*
 Dr Janita Good – *Barlow Lyde & Gilbert*
 David Grahame – *LINC Scotland*
 Wendy Hart – *Grant Thornton*
 Walter Herriot – *St John's Innovation Centre Ltd*
 Peter Hiscocks – *Judge Business School, University of Cambridge*
 Gary Le Sueur – *Scottish Equity Partnership*
 Peter Linthwaite – *BVCA*
 Finbarr Livesey – *University of Cambridge Centre for Economics and Policy*

Dr Gordon MacMillan – *Public Policy Consulting*
 Rory MacNeil – *Barra Equity Partners*
 James Mallinson – *ISIS Innovation*
 Andrew Marratt – *Marratt Ltd*
 Professor Colin Mason – *University of Strathclyde*
 Dr Nicholas Miles – *Oxford to Cambridge Arc*
 Humphrey Nokes – *ETV Capital*
 Sir Geoffrey Owen – *London School of Economics*
 Hugh Parnell – *N W Brown Ltd*
 Rupert Pearce – *Atlas Venture*
 Adrian Piper – *Bank of England*
 Professor Graham Richards – *Chairman of Chemistry, University of Oxford*
 Professor Tony Robards – *University of York*
 Dr Susan Searle – *Managing Director, Imperial Innovations*
 Peter Shakeshaft – *Archangel*
 Mark Shillito – *HSBC*
 Dr Alex Smeets – *St John's Innovation Centre Ltd*
 Adrian Smith – *Edinburgh Research and Innovation, University of Edinburgh*
 Norman Sutton – *Lloyds TSB*
 Jonathan Walker – *BlueSpa Australia Pty Ltd*
 Bill Wicksteed – *University of Cambridge Centre for Economics and Policy*
 Gill Wildman – *Plot*

¹ Titles and affiliations as at time of interview or when comments received.



Appendix 2: Report Authors

David Gill is a director of ETCapital Limited, based at the St John's Innovation Centre in Cambridge. He previously set up and ran the Innovation & Technology Unit at HSBC Bank plc in London. The Unit established professorial chairs of innovation at Brunel University and at the University of York; it also formed a national network of technology banking managers. Educated at Cambridge, David qualified as a barrister before working in corporate finance for US and UK banks. In 2004–05, he was a Sloan Fellow at the Stanford Graduate School of Business in California. He is a Visiting Research Fellow at the Technology Enterprise Group of the Institute for Manufacturing (University of Cambridge Department of Engineering).



Tim Minshall is a lecturer in the University of Cambridge Centre for Technology Management and coordinator of the Technology Enterprise Group (University of Cambridge Department of Engineering). He has worked on a range of activities in the fields of innovation and technology entrepreneurship as a researcher, consultant and company director. Before joining the University of Cambridge in 2002, he worked for St John's Innovation Centre Ltd, managing a series of technology transfer projects, funded in part by the Gatsby Charitable Foundation. Tim has a Bachelor's Degree in engineering from Aston University, and a PhD from Cambridge University Engineering Department.



Craig Pickering was born in the North East of England. He has worked as a diplomat in Brussels, a Treasury official in London and a lecturer at various universities. He is now chairman of Equity Education, which provides on-line education in stocks and shares. He is married with four children.



Martin Rigby joined the Cambridge office of 3i in 1986 as a specialist investor in start-up and early stage technology businesses. In 1992 he founded ETCapital Limited. He has made investments in nearly forty technology businesses over the past 17 years. He sits on the boards of Solcom, Astron Clinica, Oi! Bagel and WAX Info and is a non-executive director of the Cascade Seed Fund and 3en Ventures. He read history for his first degree at New College, Oxford, and was a regular army officer for seven years before completing an MBA at Cranfield University.



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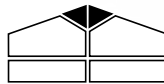
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