

Research report: September 2009

From funding gaps to thin markets

UK Government support for
early-stage venture capital



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Foreword

As we contemplate a new industrial strategy for Britain in the wake of the worst recession in over 70 years, it is clear that this must be informed by the experiences of previous policy initiatives.

In looking at the effectiveness of government-backed venture capital schemes over the past ten years, this report does exactly that and therefore comes at an opportune time for those interested in fashioning a more innovative, forward-looking Britain.

Venture capital has a central part to play in the financing of young, innovation-intensive companies with the ability to become the world leaders of tomorrow. This report demonstrates that there is a role for government-backed 'hybrid' venture capital schemes to help reach those young businesses that have difficulty accessing funds from purely private investors.

Insufficient fund size and the restrictions on the size and location of investments limit the ability of these funds to generate commercial returns. Placing geographical constraints on funds restricts them from pursuing attractive investment opportunities outside narrowly defined boundaries. Increasing the size of 'hybrid' funds to a minimum of £50 million would provide a greater number of investee companies with the resources and support to develop their businesses through to exit. It would also enable funds to invest in more high-growth companies and achieve greater diversification.

Similarly, the short-term focus on filling narrow funding gaps can stifle a company by forcing it to undertake a costly search for much-needed follow-on funding when it reaches a 'prohibited' size. The tension between regional and industrial policy is another challenge which must be met with a more flexible, bottom-up approach.

Initiatives in the UK have, in some instances, produced commendable results. The challenge now is for policy to evolve to take into account the limitations identified in this report and help the industry reach a critical mass. The establishment of a successful early-stage funding environment in the United States, via government interventions, shows what can be achieved. The opportunities in the UK are enormous and we must ensure the right framework is in place to capitalise on these opportunities if we are to produce more innovative, world-leading, high-growth companies.

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September, 2009

Executive summary

'Hybrid' venture capital schemes backed by both private and public sector funding play an increasingly important role in the risk capital funding of early-stage firms with the potential for significant growth. We analysed the impact of investment from six UK government-backed venture capital schemes on 782 funded firms over the period 1995-2008. The six schemes that are the focus of this analysis are the Enterprise Capital Funds (ECFs); Early Growth Funds (EGFs); Regional Venture Capital Funds (RVCFs); Scottish Enterprise-backed Funds; University Challenge Funds (UCFs); and Welsh Hybrid Funds. The key findings of the analysis are as follows:

These schemes have had a positive impact on firm performance, when compared to a matched control sample. There is evidence that the more recent schemes have been structured in response to lessons learnt from the earlier schemes. However, the size of their impact remains small to date.

The modest impact of these hybrid funds is open to both demand-side and supply-side interpretations. A demand-side perspective would suggest that the UK does not have a large group of high potential firms being held back by a lack of early-stage VC funding. In any economy, only a very small proportion of new firms will be capable of earning the exceptionally high returns sought by venture capital investors. An alternative, supply-side interpretation of hybrid funds' modest performance is that it reflects shortcomings in the investment decisions of some funds or

the support they provide to investee firms. Venture capital is by definition 'smart money', and expertise matters as well as cash. However, such deficiencies might be attributable, at least in part, to the investment restrictions imposed on the schemes by their government sponsors. Depending on the programme, public co-investment has been conditional on funds investing in specific regions, or investing only limited amounts in any given business, all of which may compromise fund performance. The analysis could be taken to support both the supply- and the demand-side argument. What is not in question is that effective policy solutions have to address more than just the provision of a greater supply of finance: how this finance is provided and the number of venture-ready firms matter too.

The analysis finds repeated encouraging evidence of firms that have received funding engaging in growth-oriented 'equity investment' behaviour. This involves firms undergoing disruptive changes while they build future capabilities. This produces an initial negative impact on firm performance compared to the matched sample of firms that did not receive venture capital funding. Firm performance then rebounds strongly over time as a result of the investments made. The analysis suggests it takes approximately 4-5 years to turn performance around. This pattern is observed across a number of performance metrics.

The current ineffective capital market for young, high impact firms should not be seen

as exclusively a difficulty of either the supply of finance or the demand for finance. Rather, the central concern is better understood as that of a 'thin market' where limited numbers of investors and entrepreneurial growth firms within the economy have difficulty finding and contracting with each other at reasonable costs. Thick markets, characterised by high levels of repeated interaction between venture capital (VC) and high-growth firms, are needed to build human capital in the sector and provide a large enough market for an ecosystem of high quality advisors to develop specialising in supporting early-stage VC investment.

To address this thin market, government policy needs to consider the simultaneity problem that occurs during the emergence and development of an effective VC industry. Simultaneity problems emerge because a viable VC industry requires its constituent parts to be working effectively together for extended periods of time in order to build human capital and investor confidence. These inter-related parts of an established venture capital industry include:

- Informed institutional investors (including pension funds, endowments etc.) willing to accept the risks of early-stage equity investment.
- A strong deal flow of attractive, high-potential portfolio companies.
- Large professional venture capital funds of sufficient scale and managerial competence to make initial and follow-on investments and grow portfolio firms until attractive exit opportunities are identified.
- A supportive network of high quality advisors; and efficient and liquid exit markets.

American experience suggests that such an emergent system is initially very fragile and needs decades of experience and public support to function effectively. Even the well-established US venture capital system remains highly sensitive to economic shocks.

Compared to the US, the UK largely lacks large early-stage VC funds. Supporting earlier research work, the report recommends that early-stage venture capital funds should be substantially larger than they have been in the past. This would allow them to provide follow-on

funding, diversify their investment portfolios and spread their high fixed costs. The viable size of an early-stage venture capital fund is a subject of intense debate. What is clearly known is that small early-stage funds (c. £20 million) are vulnerable to commercial failure. It is suggested that VC fund sizes should be at least £50 million¹ in order to realise minimum scale effects. Hybrid VC programmes supported by government funds have in the past been of insufficiently large size and as a consequence have reduced their probability of success.

Successful early-stage VC funds in the US require a strong deal flow of high potential firms in which to invest. This has allowed them to specialise by technology and build the technical and commercial knowledge required to identify, support and promote the rapid growth of world class, new technology-based young firms. Government policy should also recognise that this need for a strong deal flow creates a tension between regional and innovation policy. Outside Greater London and the South-East, VC funds constrained to invest by UK region are unlikely to have a sufficiently large enough pool of high-potential firms to be commercially viable. On the contrary, large, specialised and successful venture capital funds in the European Union focusing on innovative firms are increasingly likely to operate at a trans-continental or increasingly global scale.

Public support conditions that keep publicly funded VC funds operating strictly within the currently recognised 'funding gap' also inhibit them operating in an effective commercial manner.² Such conditions severely limit fund managers' freedom to make follow-on investments. As a result, a fund's ownership of an attractive growth company is heavily diluted in subsequent funding rounds, substantially reducing the original investors' capital gain opportunities. The 'drip feeding' of funding means that high potential portfolio companies have their funding restricted during their periods of early growth unless alternative private investment is available. Fund managers also have fewer opportunities to learn how to help grow firms in ways that generate exceptional returns, in a comparable manner to the most successful private venture capital funds in the US or UK. The resulting system is neither growth nor success oriented.

Separate policies and programmes that focus exclusively on filling narrow funding gaps with the assistance of public money can be counter-productive as they can create artificial barriers between successive

1. Murray, G. C. 1999. 'Early-stage, venture capital funds, scale economies and public support', *Venture Capital*, 1, (4) pp 351-384; Murray, G. C. and Marriott, R. 1998. 'Why has the investment performance of technology-specialist, European venture capital funds been so poor?', *Research Policy*, 27, pp. 947-76.

2. It should be recognised that these constraints are not necessarily exclusively imposed by domestic governments. The need to meet the strictures of EC competition policy can markedly influence the scale of public funding that can be made available.

rounds of funding. Such barriers are disruptive and costly (in time, money and managerial resources) for both venture capital investors and portfolio firms. Policy should be more systematic, focusing on improving the flow of multiple funding rounds to high potential young firms as they grow, thereby providing a 'funding escalator' from formation to IPO or trade sale. This is likely to involve both Business Angel (BA) and venture capital funding.

Improved support for Business Angel networks is encouraging, and is a good example of a 'demand side' policy that seeks to improve the flow of high-quality firms available to the VC sector. The Business Angel environment in the UK has evolved from a fragmented system of anonymous individuals to an increasingly co-ordinated network of professionally organised groups. The best Angel groups can now make sizeable initial investments and undertake appropriate follow-on investments in a manner that is as professional as equivalent venture capital investors. Improving the flow of high quality deals from such networks to venture capital funds should be a priority.

While the UK has not as yet produced a VC funding system focused on innovative and exceptional companies comparable with the best in the United States, the analysis does find encouraging evidence of change. Given that it took over 50 years of experimentation in the United States to produce the system in operation today, the speed at which the UK system is learning from policy experiments and improving should be recognised. The UK is increasingly well positioned to exploit improvements in the financing of high-potential firms and there is good reason to expect more positive outcomes in the future.

Definitions and distinctions

In this report we will frequently use the following terms: venture capital, private equity, risk capital, hybrid fund and early-stage investment. These terms often mean different things to an American, a European, an investor or an entrepreneur, which can cause considerable confusion.³ Accordingly, when we refer to venture capital in this report, we will use the term as it is commonly understood in the USA:⁴ the process of external equity finance provision by professional investors in a new or young (i.e. early-stage) company to create new assets for the primary purpose of reaping substantial economic gain through an attractively priced market flotation (initial public offering) or trade sale.

Venture capitalists primarily invest equity in young companies in return for a significant part ownership of a business that they perceive has exceptional growth prospects. Venture capitalists are highly engaged and informed investors who provide substantial advice and governance to the entrepreneurial management team as they grow the company and move towards a successful exit. This 'classic' venture capital industry is largely focused on knowledge-based industries and accordingly typically has strong links to university and other research centres. Venture capitalists primarily invest in areas where technology and other innovations are being developed that have exceptional commercial potential because of their potentially disruptive effect on existing business practice and incumbent firms.

As the UK industry has grown and matured, investors have often found it very difficult to replicate the successes of the US VC market when investing in early-stage companies. As a result, some prominent investors have moved to invest in larger, later stage businesses where

the risks and uncertainties are less extreme. This has led to a hiatus in funding for the youngest companies which has been widely termed 'the equity gap'. This gap is often seen as a market failure. If the affected firms genuinely have high potential, this gap would warrant public intervention to address and correct any under-investment. As a result, the State has been drawn into this market both as an alternative investor to venture capital firms, and as a co-investor with them. Arrangements where the state invests in a venture capital fund managed by a commercial venture capitalist are termed 'hybrid' VC funds.⁵

This report does not address Private Equity (PE) investment or its primary interest in refinancing and restructuring of existing assets (rather than the creation of new assets). Governments very rarely intervene directly to promote or engage in PE, which has grown significantly to become an important and profitable activity in the UK. Private equity investing is largely focused on management buy-outs, buy-ins and other later stage development finance. Where the term is used it is primarily done so in order to make a specific comparison with venture capital activity. In the USA, the private equity industry is clearly separated from the VC industry. In Europe and elsewhere, venture capital and private equity activities are commonly intermingled and the terms are often used interchangeably (thereby often promoting confusion).

3. European Commission and the United States Department of Commerce International Trade Administration (2005) 'Working group on venture capital. Final report.' Brussels: European Commission.

4. Bygrave, W.D. and Timmons, J.A. (1992) 'Venture Capital at the Crossroad.' Cambridge, MA: Harvard Business School Press; and European Commission (2006) 'Developing European private equity – report of the alternative investment expert group.' Brussels: European Commission.

5. OECD (2004) 'Venture Capital: Trends and Policy Recommendations. Science Technology Industry.' Paris: OECD.

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NESTA is the National Endowment for Science, Technology and the Arts.

Our aim is to transform the UK's capacity for innovation. We invest in early-stage companies, inform innovation policy and encourage a culture that helps innovation to flourish.

The BVCA is the industry body and public policy advocate for the private equity and venture capital industry in the UK. With a membership of over 450 firms, we represent the vast majority of all UK-based private equity and venture capital firms and their advisors.

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6. Gompers, P. and Lerner, J. (2001) The Venture Capital Revolution. 'Journal of Economic Perspectives.' 15, 2, pp.145-168; Reynolds, P.D., Hay, M., Bygrave, W.D., Camp, S.M. and Autio, E. (2000) 'Global Entrepreneurship Monitor: 2000 Executive Report.' Kansas City: Kauffman Centre for Entrepreneurial Leadership.
7. Shane, S. (2008) 'The illusions of entrepreneurship: the costly myths that entrepreneurs, investors and policy makers live by.' New Haven: Yale University Press.
8. The fact that many UK high tech start ups are acquired by foreign firms is not necessarily a bad thing. The UK economy benefits substantially from an open, international market in technology. The issue is that the UK could probably benefit more if conditions were in place to make growing global technology firms easier.
9. For equivalent European policy concerns see European Commission (2006) 'Developing European private equity – report of the alternative investment expert group.' Brussels: European Commission.
10. Bottazzi, L. and Da Rin, M. (2002) Venture capital in Europe and the financing of innovative companies. 'Economic Policy.' 17 (34), pp.229-270.
11. Dantas, C., Rosa, M. and Raade, K. (2006) 'Profitability of venture capital investment in Europe and the United States.' Economic Papers Number 245. Brussels: European Commission, Directorate-General for Economic and Financial Affairs.
12. Lerner, J. (1999) The Government as Venture Capitalist: the Long-Run Impact of the SBIR Program. 'Journal of Business.' Vol. 72(3), pp.285-318.
13. Almeida Capital (2005) 'A mapping study of venture capital provision to SMEs in England.' London: Small Business Service.
14. Pierrakis, Y. and Mason, C. (2008) 'Shifting sands: The changing nature of the early-stage venture capital market in the UK.' London: NESTA.

1. Introduction

Venture capital is widely recognised to be a key driver of economic development in advanced economies and a major source of finance for innovative, high-growth firms and their entrepreneurial owner-managers.⁶ Venture capital investment in early-stage firms has been responsible for helping to create and grow many of today's most iconic global technology companies including Intel, Apple, eBay, Google and Genentech.⁷ Perhaps less visibly, venture capital-backed firms have also made major contributions to the rapid commercialisation of advanced technologies in medicine and new materials.

Unfortunately, the US's dominant success in the commercialisation of new technologies has not been replicated to the same degree elsewhere. The UK has been successful in producing very competitive, high-tech start-ups, many of which have subsequently been bought by foreign firms.⁸ However, it has largely failed to grow these enterprises into independent, global firms. Similarly, despite substantial investment, recent attempts to build high-tech clusters have produced disappointing results. This is a major policy concern and has focused policy attention on the provision of professional risk capital finance and management expertise.⁹

Total UK venture capital investment is substantially below US levels, with individual firms receiving smaller amounts of funding than comparable US firms.¹⁰ Moreover, despite a substantial rise in the total amount of private equity available since the 1990s, financial institutions have generally not invested in early-stage VC funds in the UK. This relative lack of institutional commitment to VC

(compared to the continued international support for UK private equity funds) makes it increasingly difficult to create early-stage VC funds and fund early-stage ventures.

This absence of commitment has in large part been because, with few exceptions, the returns to early-stage VC funds have been both low and erratic outside the USA.¹¹ As a result, many commercially focused funds and their limited partner investors have moved into later stage investment, where returns have been higher and more persistent. This exodus has left a funding gap for young growth-oriented firms seeking risk capital investment in amounts beyond £250,000 that are too large for business angels but too small for a majority of venture capitalists. The emergence of this funding gap has drawn governments across the industrialised world into the direct provision of support for venture capital investing.¹²

The UK Government has been one of the most innovative in developing a range of such early-stage, equity finance programmes.¹³ Previous research by Pierrakis and Mason¹⁴ has shown that these public co-investment policies (often termed 'hybrid' funds) now make up over half the early-stage investment (by number). Given that their importance is likely to grow if the credit crunch continues to reduce private investment in venture capital funds, it is important to understand how they operate.

This report summarises the results of a research project exploring the impact of publicly financed support schemes on firm performance. The research aims to determine what policy lessons can be learned from existing support mechanisms when designing the next generation of 'hybrid' venture capital programmes. Rather than looking at relative

levels of overall funding, which only measure inputs, we explore the transformational impact of public schemes on the recipient firms.¹⁵ We do this because the key policy concern is not aggregate levels of inputs, but how resources (inputs) are allocated to support activities that raise productivity. Economists have increasingly highlighted how little economic growth can be explained by the accumulation of inputs, such as physical capital. Instead, economic growth is driven by how effectively resources are allocated in the economy to more productive activities. This has focused policy attention on entrepreneurs and venture capitalists as economic actors who identify such opportunities and allocate financial and managerial resources to exceptionally high impact investments.¹⁶

Understanding how effectively current public policy can support this allocation of resources is important for two reasons. First, many of the schemes that are explored in this report were originally developed during the early-stages of the ‘technology bubble’ of the late 1990s, and were influenced by the New Economy thinking of the time. As a result, politicians underestimated the difficulties involved in rapidly building a viable, growth-focused VC industry and, in so doing, solving the funding problems of high-growth, high-impact firms. Future policymaking will need to be based on a more realistic understanding of risk equity provision.

Secondly, given the current credit crunch, the funding of equity of all kinds is likely to change. The ready availability of cheap debt has been severely curtailed, and the rebalancing of investment portfolios after equities have fallen in value may reduce the funds going into private equity and venture capital. On the other hand, the recession has reduced the returns from many traditional asset classes. Institutional investors accustomed to high returns may look again at alternative investments if they offer some possibility of realising higher yields. Moreover, many firms with active revenue streams are turning to venture capital after being turned down by banks. The impact of these changes will be influenced by how effectively public policy can be developed and implemented. One of the aims of this report is to help in this process.

2. Venture capital: a short introduction

Despite the significant impact of venture capital as a source of funding for elite new businesses, it is not a well understood phenomenon. As noted earlier, we use an American definition that encompasses external professional investment in a new or young (i.e. early-stage) company to create new assets to reap substantial economic gain through an attractively priced flotation or trade sale.

This type of financing has four distinctive features. First, because venture capital funding, unlike debt funding, transfers part of the ownership risk from the entrepreneur to the investor, it encourages venture capitalists to provide managerial support to entrepreneurs.¹⁷ The most successful and experienced venture capital firms have considerable managerial expertise, and the transfer of this expertise can have a major influence on the success of their portfolio firms. The persistent superior performance of the top quartile VC funds highlights the importance of this human capital for portfolio firm success.^{18, 19}

Second, venture capital is highly selective. Because venture capital is a very costly form of finance with many failed or disappointing investments, VCs need to generate very high financial returns on their successful investments in order to be economically viable. As a result, only a small number of exceptional firms are likely to attract their attention. Approximately 3,000 US firms get venture capital investment each year, including 500 start ups.²⁰ Moreover, almost all these recipient firms are concentrated in a small number of high-growth industries focused on ICT, healthcare, information and now, increasingly in 2009, on clean technologies.^{21, 22} Venture capital is therefore a very specialised type of financing for a small and exceptional cadre of high-growth companies. Venture capital is small as a proportion of both the total investment in start-up firms (about 1.9 per cent in the US) and tiny as a percentage of the number of firms that receive investment. It is not a financial instrument appropriate for the vast majority of firms. This caveat is important when promoting venture capital as a policy instrument.

Third, the mixture of high skills and high selectivity mean the returns to investment are very highly skewed. The majority of all returns come from the top quartile of funds. In early-stage classic venture capital activity, a majority of investments in a portfolio will either fail or return (at best) a negligible net

15. While there is a long history in UK public policy of focusing on inputs, and particularly relative levels of investments in international comparisons, the key policy issue is how inputs are efficiently turned into outputs. Inputs may be easier to measure, compare and influence, but productivity is the more important issue as recognised by its priority in Government policy.
16. Audretsch, D.B., Bönte, W. et al. (2008) Entrepreneurship capital and its impact on knowledge diffusion and economic performance. *Journal of Business Venturing*: 23(6), pp.687-698.
17. Sapienza, H., Manigart, S. and Vermeir, W. (1996) Venture capitalist governance and value added in four countries. *Journal of Business Venturing*: 11(6), pp.439-469.
18. The recognition of the quality of key investment management is reflected in the means by which the VC firms seek to ‘lock in’ star performers by skewing rewards to the final distribution of the ‘carry’ (i.e. capital gain shared by the general partners) of the fund. To acquire a senior manager a new general partnership will have to literally buy the new hire out of his or her existing carry entitlement. This sum may amount to tens of millions of dollars in a top quartile fund.
19. Gompers, P. (1996) Grandstanding in the Venture Capital Industry. *Journal of Financial Economics*: 42, pp.133-156.
20. Shane, S. (2008) *The illusions of entrepreneurship: the costly myths that entrepreneurs, investors and policy makers live by.* New Haven: Yale University Press. p.90.
21. Deloitte Touche Tohmatsu (2009) *Global Trends in Venture Capital: 2009 Report.* New York: Deloitte.
22. Clean technology covers green, environmental and renewable technologies where there has been a large increase in US VC interest in recent years.

23. Murray, G.C. and Marriott, R. (1998) Why has the Investment Performance of Technology-Specialist, European Venture Capital Funds been so Poor? 'Research Policy.' 27, pp.947-976.
24. Shane, S. (2008) 'The illusions of entrepreneurship: the costly myths that entrepreneurs, investors and policy makers live by.' New Haven: Yale University Press. p.162.
25. Bottazzi, L. and Da Rin, M. (2002) Venture capital in Europe and the financing of innovative companies. 'Economic Policy.' 17 (34), pp.229-270; Lerner, J. (2002) When Bureaucrats Meet Entrepreneurs: the Design of Effective 'Public Venture Capital' Programs. 'Economic Journal.' Vol. 112, pp.F73-84; Murray, G.C. (2008) Venture capital and government policy. Chapter 5 in Landström, H. (Ed.) 'Handbook of Research on Venture Capital.' London: Edward Elgar Publishing Ltd.
26. Auerswald, P.E. and Branscomb, L.M. (2003) Valleys of Death and Darwinian Seas: Financing the Invention to Innovation Transition in the United States. 'Journal of Technology Transfer.' 28 (3-4), p.227.
27. Lerner, J. (1999) The Government as Venture Capitalist: the Long-Run Impact of the SBIR Program. 'Journal of Business.' Vol. 72 (3), pp.285-318; Hsu, D. and Kenney, M. (2005) Organizing venture capital: The rise and demise of American Research & Development Corporation. 'Industrial and Corporate Change.' 14:4, p.579.
28. Essentially, path dependency arguments suggest that national policymakers have to recognise that they have to craft policies that reflect their own national history, resources and circumstances which may be quite different from those that have pertained in exemplar countries.
29. US 'earnings' focused regulations transfer more risk from the entrepreneur onto the investor than EU-style 'stewardship' focused regulations. This helps partially de-risk firms seeking finance from the public markets. While this has benefits for firms with unproven technologies, it also carries risks and would be politically unacceptable in Europe.
30. OECD (2004) 'Venture Capital: Trends and Policy Recommendations. Science Technology Industry.' Paris: OECD.
31. Murray and Liu in their 2009 unpublished review of 16 developed economies found 31 hybrid schemes in operation.

present value when the time cost of money and an appropriate risk premium are computed.²³ Where attractive net returns are made by the fund, it is likely to result from the realisation of a small minority of exceptional investments within the portfolio. One consequence of this is that venture as an asset class shows extremely large variation in returns. Statements about the performance, funding, skill and structure of 'premiership' funds are unlikely to apply to the average fund.

Fourth, venture capital has had a powerful and disproportionate impact on the US economy. As Shane²⁴ notes: "since 1970, venture capitalists have funded an average of 820 new companies per year. These VC supported start ups – a tiny proportion of the more than two million attempted business entries every year – have created enormous economic impacts. By 2003, companies that had been backed by VC employed 10 million people, or 9.4 per cent of the private sector labour force, and generated \$1.8 trillion in sales... In 2000, the 2,180 publicly traded companies that had received venture capital backing between 1972 and 2000 comprised 20 per cent of all public companies, 11 per cent of sales, 13 per cent of profits, 6 per cent of employees, and one third of total market value, a figure in excess of \$2.7 trillion dollars... In short, a very significant proportion all of the value generated by start ups in the USA has come from this handful of VC backed firms". A well functioning VC funding system therefore generates substantial positive 'spill over' effects to the rest of the economy, despite its relatively small size, because of its role in allocating funding and managerial expertise.

The data on the importance of VC-backed firms to the US economy can be used to estimate what might be expected in the UK. If the US economy generates 600-800 VC-investable firms each year, the UK might be expected to generate 50-60 based on relative GDP (ignoring the lower levels of investment in research in the UK). If one assumes that one in ten of these firms might generate exceptional performance, the UK VC industry might be expected to generate five US-style large firms a year – or 50 firms in the last decade. Experience suggests the actual number is substantially less. This, in turn, suggests that the UK sector is underdeveloped and/or has constraints that are not faced by the US.

3. Government policy to support venture capital investment

The disproportionate impact of VC-backed firms on the US economy is one reason why economists and policymakers are increasingly interested in the unique role of venture capitalists in allocating resources and expertise to that small percentage of high impact young ventures. Virtually every major economy has implemented initiatives to promote early-stage venture capital.²⁵ New knowledge-based firms are a particular focus of such financing initiatives. However, even in the United States, government programmes have provided about 20-25 per cent of the total amount of money invested in early-stage technology firms. This sum is about equal to the total investments of 'business angels' and about two to eight times the amount invested by private venture capital firms.²⁶

However, finding the correct policies to support early-stage equity investment in highly speculative and nascent businesses is not easy and requires repeated cycles of experimentation and learning. The United States has taken over 50 years of experimentation to generate appropriate and effective forms of support. Even so, world class venture capital expertise in the USA is limited to a few clusters adjacent to the leading universities on the East and West coasts. Inevitably, many of the early policy interventions were of limited value. Public schemes that provided tax incentives were exploited for tax avoidance while other schemes were subject to partisan political control and accordingly saw finance diverted towards unproductive investments.²⁷ The Small Business Investment Company scheme, the Advanced Technology Programme and the Small Business Innovation Research program, which are often seen as exemplars, have all suffered major operational problems which have resulted in either major programme changes or cancellation.

The difficulties that Americans have had in getting their own support institutions to work suggest that it is unrealistic to expect US-style institutions to be easily transferable to other countries. The concept of 'path dependency' needs to be appreciated by policymakers.²⁸ The US market also has many unique environmental features that cannot be taken for granted elsewhere. For example, it enjoys a pro-active industrial policy, levels of research funding larger than all other G7 countries combined, risk-receptive securities market regulations,²⁹

large IT firms in Silicon Valley and beyond, and a large number of entrepreneurial and well-informed early-stage investors. In addition, the US has a very well developed infrastructure of entrepreneurial education and training. They all contribute to making the US venture capital industry pre-eminent and distinctive. As a result, policymakers outside the US have had to experiment with bespoke policy measures within their own national contexts.

While many governments initially established their own VC funds, these have been largely abandoned as investment decisions were distorted by political influence. Government officials typically lacked the capabilities required to assess and manage investment opportunities, and the funds themselves had the potential to 'crowd out' private sector investors. Today government policy in support of VC typically takes the form of capital participation in which the state invests as a special limited partner in a venture capital fund managed by a commercial venture capitalist.³⁰ In such schemes, the state devolves the responsibility for commercial investment decisions to the private VC partner once the general focus, objective and distribution of incentives of the fund are negotiated and agreed with its public and private stakeholders.

Examples of such schemes include the Australian Industry Investment Fund, the German High-tech Gründerfonds, the Israeli Yozma programme and the New Zealand Venture Investment Fund.³¹ Additionally, several hybrid schemes often involve some kind of downside protection against losses or upside leverage of private limited partners' investments in order to address the low returns typically associated with the majority of early-stage investment.³² These programmes rarely, however, address 'demand side' problems associated with the poorly developed quality of the firms that may be seeking investment or the lack of skills within the local VC industry needed to find, build and sell a profitable portfolio of firms.³³ In a policy context, this is a crucial omission.

4. A short history of hybrid funding schemes in the UK

The UK government has developed a range of 'hybrid' VC funds designed to pursue entrepreneurial policy objectives. These policy experiments focus on a "small but important minority of innovative, growth orientated

business that continue to have difficulties in attracting funding, particularly between £250,000 and £2 million".³⁴ On government assumptions, equity investment in this range would be attractive to between 6,000 and 12,000 firms which do not get funding each year.³⁵ While appreciating that many of these firms will be unsuitable for venture capital funding, early-stage venture capital still appears to be underused by firms which would benefit from such access.³⁶

The UK has had a long experience with such government interventions in the capital markets used by small and medium sized firms (SMEs), a tradition going back to the formation of the Industrial and Commercial Finance Corporation (ICFC) in 1945. Significant public policy attention continued to be given to small firm financing, in the Radcliffe report (1959),³⁷ the Bolton Report (1971)³⁸ and the Wilson Report (1980).³⁹ However, the biggest changes started after the 1979 election with an increased emphasis by the Thatcher government on small entrepreneurial firms as underexploited sources of job creation and economic growth.⁴⁰ By the 1983 election, the Conservative government had introduced 108 policies, many of which focused on removing market failures and other funding constraints that prevented small firms contributing fully to UK growth and prosperity.⁴¹

Just because firms have difficulty finding funding does not mean that a market failure exists or that government policy intervention would improve the situation. In a sophisticated, competitive market economy such as the UK, many firms will enter the market with little chance of success. Most of these firms will simply generate economic 'churn' and will either exit rapidly or displace similarly marginal firms. As a result, many firms seeking funding will be refused and many firms that are refused funding will fail. A perceived funding gap could therefore be the result of investors rationally assessing firms and deciding that they are not worth investing in given the levels of incurred risk.

Government policies that encourage the market entry of such substandard firms are likely to be a waste of money.⁴² However, if significant numbers of high-potential firms are not receiving sufficient funding to maximise their efficient economic output, government intervention to address any under-investment or market failure would be warranted.⁴³ This is particularly the case if funding problems constrain the growth of the very small number

32. Jääskeläinen, M., Maula, M.V. and Murray, G. (2007) Profit Distribution and Compensation Structures in Publicly and Privately Funded Hybrid Venture Capital Funds. 'Research Policy,' 36(7), pp.913-929.
33. Toschi, L. and Murray, G.C. (2009) 'A cross-country review on investment readiness. How can small and medium size enterprises increase their attitude towards equity finance?' London: Department for Business, Innovation and Skills.
34. HMT/SBS (2003) 'Bridging the finance gap: next steps in improving access to growth capital for small businesses.' London: HM Treasury and Small Business Service. p.61.
35. Ibid.
36. 6,000 to 12,000 firms is larger than the total number of firms that receive VC funding in the US each year.
37. Radcliffe Report (1959) 'Committee on the Working of the Monetary System.' Report, Cmnd. 8270. London: HMSO.
38. Bolton J.E. (1971) 'Report of the Committee of Enquiry on Small Firms.' Cmnd. 4811. London: HMSO.
39. Wilson, H. (1980) 'Report of the Committee to Review the Functioning of Financial Institutions.' London: HMSO.
40. This coincided with increased academic research on small firms. The MIT economist David Birch suggested in 1979 that 80 per cent of net new jobs created in the United States were created by small firms. Later research found that small establishments generated the majority of new jobs, but most of these were created in small plants owned by large firms (Arington and Odel, 1982). Moreover, most of the jobs created by small firms quickly disappear (Brown, Hamilton and Medoff, 1990). Today academics are more sceptical about public policy that supports small firms' market entry and suggest that policy should focus on the small minority of high impact firms (Storey, 1998; for a comprehensive review of the evidence see Santarelli and Vivarelli, 2007)
41. Mason, C. and Harrison, R. (1986) The Regional Impact of Public Policy towards Small Firms in the UK. In Keeble, D. and Wever, E. (Eds) 'New Firms and Regional Development in Europe.' London: Routledge.
42. Santarelli, E. and Vivarelli, M. (2007) Entrepreneurship and the process of firms' entry, survival and growth.

'Industrial and Corporate Change.' 16:3, pp.455-488.

43. A market failure occurs when the price mechanism fails to produce a socially optimal outcome. In the context of provision of risk capital to small firms, this can occur if economic actors cannot capture the full economic and social value of their investments. As a result, all other things being equal, investors faced with market failures will provide less finance than would be effectively and profitably employed in the absence of market failures. Since this situation is socially suboptimal, it provides a justification for public intervention as a possible contingent response to market shortcomings.
44. Storey, D.J. (1998) 'The Ten Percenters. Fourth Report: Fast Growing SMEs in Great Britain.' London: Deloitte Touche Tohmatsu.
45. The EIS aims to provide small, higher risk unquoted companies with access to external growth capital. This is done through a range of tax relief for private individuals investing in qualifying shares. The scheme provides 20 per cent tax relief up to £500,000 per annum, a capital gains deferral at 40 per cent if the investment is held for at least three years before disposal, and income tax relief on losses. Over time the constraints on EIS have been reduced and the minimum holding time has come down from five years to three years as of April 2000. Similarly, the limits on the size of investment have been relaxed from £150,000 in 2000, to £200,000 in 2004, to £400,000 in 2006 and £500,000 in the 2008 budget.
46. VCTs started in 1995 as a retail investment vehicle for individuals to invest indirectly in a portfolio of enterprises through a managed fund. The investment is passive for the investor, but VCTs can take an active role in supporting the firms they invest in. Each VCT can invest up to £1m per year in a qualifying company and substantial tax relief is given if the shares in the VCT are held for 3 years (previously 5 years). VCTs operate like investment trusts and qualify for tax breaks if they gain most of their income from shares and securities with at least 70 per cent coming from 'qualifying holdings'. To overcome the £1m investment constraint VCT managers run a series of VCTs to allow them to invest at higher levels. Changes in the 2006 Finance Act have tightened the range of investments that VCTs can invest in, and since then investments have declined.

of high-growth firms that could create jobs and drive significant economic growth.⁴⁴

A range of policy interventions was introduced in the early 1980s to resolve market failures in funding SMEs. These included the *Small Firm Loan Guarantee Scheme* (SFLGS) which has provided over 100,000 guarantees of almost £4 billion to over 90,000 eligible businesses. To support firms that are suitable for external equity funding, the *Business Start up Scheme* was introduced in 1981. The scheme was over complicated and liable to the sorts of tax avoidance abuses that plagued early US schemes. It was quickly superseded by the *Business Expansion Scheme* in 1983 which provided tax relief on investments in unquoted growth oriented companies. While the scheme provided much needed investment around the £100,000 mark, much of the investment went into low risk, asset-backed enterprises. This was similar to the experience in equivalent US schemes, and was particularly the case after 1988 when investments were permitted in private rented housing.

As a result, by the mid-1990s, a new wave of policy instruments was introduced. By luck or design, the *Enterprise Investment Scheme* (EIS), the *Venture Capital Trust* (VCT) scheme and the formation of the *Alternative Investment Market* (AIM) introduced an implicit funding escalator going from a few hundred thousand pounds (EIS), to over £1 million (VCT), to tens of millions of pounds (AIM).

EIS provides tax relief-based incentives for private investors (including business angels) to invest in small, higher risk unquoted companies.⁴⁵ To address those retail investors who need to diversify their portfolio, the VCT scheme allows individuals to invest indirectly in a portfolio of companies through a professionally managed fund. Like the EIS scheme, VCTs qualify for a range of tax breaks and have been important in channelling equity investment into small firms and improving the liquidity of the AIM market.⁴⁶

When members of the research team evaluated the impact of the EIS and VCT schemes last year⁴⁷ they found evidence of an increased rate of accumulation of fixed assets, an increased rate of job creation, and increased sales turnover. However, they also found that firms had lower profit margins and survival rates when compared to matched firms. These effects were statistically significant but small. Lower survival rates also included both voluntary exits and the acquisition of attractive

enterprises by larger firms and so should not necessarily be interpreted negatively. Similarly, lower profit margins are also to be expected for schemes investing in young, growth-orientated, and often pre-profit firms.

5. The 1998 Competitiveness White Paper

The New Labour government elected in 1997 introduced a range of additional policies in the 1998 *Competitiveness White Paper*. These ideas had been developed during the start of the technology bubble of the late 1990s. As a result, they were heavily influenced by New Economy thinking that the basis of competition had changed and was increasingly driven by knowledge and intangible assets. Since firms based on intangible intellectual assets have less collateral to put up for loans, they are particularly suitable for equity investments.⁴⁸

Firms based on intangible assets also often have a combination of higher initial costs (for research and product development), and lower production and distribution costs compared to traditional Old Economy firms (e.g. software versus automobiles). These characteristics make them more likely to seek VC funding as they require more early-stage funding than they can generate through sales. They often have the opportunity to exploit powerful network-effects once sales start to be generated (for example, by using the internet for distribution or marketing).

As a result, the White Paper had a substantial focus on supporting venture capital provision throughout the UK. It announced the formation of a £270 million *Enterprise Fund* working in partnership with the private sector to address market weaknesses through the *SFLGS*, *Regional Enterprise Funds*, a *UK High Tech Fund of Funds*, and an *Early Growth Fund*. A fifth element involving attention to *Investment Readiness* was added later following academic criticisms.⁴⁹ These policy interventions were justified on the belief in the existence of a "market failure in the provision of finance in amounts below £500,000 for SMEs with growth aspirations".⁵⁰

The funds had three objectives: first, to increase the amount of equity finance to growing SMEs; second, to ensure the nine English regions and their local firms had access to local smaller scale equity investors; and third, to "demonstrate to potential investors in

early-stage venture capital funds that robust returns can be made by funds investing in the equity gap, thereby promoting the private sector venture capital industry".⁵¹ At the time, it was widely believed by politicians that an initial investment would 'pump prime' the entire market. This belief was based on an erroneous view of the workings of the US venture capital industry and an assumption that the bull market for technology stocks was more substantial and long term than it turned out to be.

An autonomous regional venture capital fund (RVCF) was set up in each of the nine English regions run by private VC general partnerships mandated to make commercial investments below £500,000 (later £660,000) with initial investments of up to £250,000. By 2006, the National Audit Office reported that the government had committed £74.4 million of public finance to the RVCFs which has amassed approximately £250 million funds under management.^{52, 53}

While the funds were commercially focused, the government recognised a market weakness that could be addressed by either a) subsidising management costs, b) providing guarantees for funds, or c) co-investing in funds to attract further investors. Returns to the public investors in these hybrid funds were either capped and/or 'subordinated', i.e. the public investor bore the first loss.⁵⁴ However, subsidies weaken the exposure of fund managers to poor investment choices. Similarly, guarantees nullify the aim of demonstrating that institutional investors can make money in the equity gap.⁵⁵ As a consequence, an equity enhancement structure was used that recognises government's historic poor ability to make commercially successful investment decisions.⁵⁶

Each fund typically raised 50 per cent of its money from the private sector with a further 30 per cent from the former Department of Trade and Industry (now the Department for Business, Innovation and Skills) and 20 per cent from the European Investment Fund. The schemes were delayed by European 'State Aid' concerns. However, following approval by the European Commission in June 2001 the first schemes were set up in January 2002, with seven set up by November 2002 and the remaining two launched in 2002-3.

In addition to the RVCFs, a series of *University Challenge Funds* (UCFs) were co-funded by the government, the Wellcome Trust, the Gatsby

Foundation and participating universities. They were intended to provide proof-of-technology and proof-of-market funding for the initial commercialisation of academic research. Nineteen funds were set up in total eventually covering more than 50 institutions.⁵⁷

The White Paper also established a *High Technology Fund of Funds* to provide equity to existing technology-focused VC funds to demonstrate that commercial returns were possible from investing in technology, and attract new institutional investment into technology-based firms. The initial investment of £20 million from the government was used to raise £106 million from institutional investors thus creating a £126 million fund-of-funds.

Lastly, the White Paper established *Early Growth Funds* (EGFs) to provide small amounts of equity finance based on angel co-investment, employing a quasi-equity approach. These investments are linked to business support to enhance the recipient firms' chances of success. The EGFs were established to ensure that every English region has access to early growth funding of up to £100,000 per recipient firm.⁵⁸ While the EGFs were originally intended to be regional, operational problems with the regional focus of the RVCFs meant that they evolved into a mixture of regional and national funds.

Almost as soon as the schemes were set up, Mason and Harrison⁵⁹ suggested they might have some design problems. The exclusive focus on the supply side failed to address the possibility that the lack of investment arose from a limited number of investment opportunities. As a consequence, subsidised funding ran the risk of driving existing private sector VC funds out of the market. They were also concerned about a lack of managerial talent as (a) only 17 prospective managers (two of whom withdrew) applied for the nine regional funds, (b) RDAs complained about a lack of competition, and (c) WM Enterprise and Yorkshire Fund Managers were selected to manage five of the nine funds.⁶⁰

Mason and Harrison⁶¹ also raised concerns that the funding gap had been misidentified because the government drew on misleading statistics that ignored the early-stage investment activities of Business Angels. Most Business Angels invest less than £100,000 per firm, focused on the seed and start-up phases and regularly form organised groups of between 10 and 100 investors to invest over £250,000 per deal.⁶² As a consequence,

47. Cowling, M., Bates, P., Jagger, N. and Murray, G. (2008) 'Study of the impact of the Enterprise Investment Scheme (EIS) and Venture Capital Trusts (VCTs) on company performance.' London: HMT.
48. Bank of England (1996) 'The financing of technology based firms. Domestic finance division.' London: Bank of England; Storey, D.J. and Tether, B.S. (1998) 'New technology-based firms in the European Union: an introduction.' *Research Policy*, 26, pp.933-946.
49. Mason, C.M. and Harrison, R.T. (2001) 'Investment Readiness: A Critique Of Government Proposals To Increase The Demand For Venture Capital.' *Regional Studies*, Vol. 34, pp.663-668.
50. Department of Trade and Industry (1999) 'Addressing the SME equity gap: support for Regional Venture Capital Funds.' Consultation document, URN99/876, SME Policy Directorate Report on Consultation on Regional Venture Capital Funds. London: HMSO. Paragraph 1.11.
51. Mason, C.M. and Harrison, R.T. (2003) 'Closing the Regional Equity Gap? A Critique of the Department of Trade and Industry's Regional Venture Capital Funds Initiative.' *Regional Studies*, 37(8), pp.855-868.
52. National Audit Office (2006) 'Supporting Small Business, Report by the Comptroller and Auditor General.' HC 962 Session 2005-2006. London: NAO. p.24.
53. In 2004-05, £20 million of Government expenditure supported investment in 61 firms and by the end of 2005, 218 firms had been supported (see *Ibid.*).
54. Department of Trade and Industry (1999) 'Addressing the SME equity gap: support for Regional Venture Capital Funds.' Consultation document, URN99/876, SME Policy Directorate Report on Consultation on Regional Venture Capital Funds. London: HMSO. Paragraph 2.5.
55. Mason, C.M. and Harrison, R.T. (2003) 'Closing the Regional Equity Gap? A Critique of the Department of Trade and Industry's Regional Venture Capital Funds Initiative.' *Regional Studies*, 37(8), pp.855-868.
56. OECD (2004) 'Venture Capital: Trends and Policy Recommendations. Science Technology Industry.' Paris: OECD.

57. The funds were set up in competitive rounds as policy experiments, with 15 seed funds set up in the first round in 1999 (£45m) and four more in the second round in 2001 (£15m). The funds themselves were small and varied in their investing approach. Eventually, the schemes were replaced by the University Higher Education Innovation Fund (HEIF). Interviewees suggested that these funds played important roles in helping to professionalise Universities' interactions with the commercial world.
58. The first fund started in October 2002. By 2005, £5.3 million had been invested in 65 businesses and by the end of 2005, 107 small businesses had been supported (NAO, 2006:25). By 2006, seven funds were operational and had invested nearly £16 million of public money matched by approximately £43.5 million of private sector money into 136 businesses.
59. Mason, C.M. and Harrison, R.T. (2001) *Investment Readiness: A Critique Of Government Proposals To Increase The Demand For Venture Capital*. 'Regional Studies.' Vol. 34, pp.663-668; Mason, C.M. and Harrison, R.T. (2003) *Closing the Regional Equity Gap? A Critique of the Department of Trade and Industry's Regional Venture Capital Funds Initiative*. 'Regional Studies.' 1360-0591, 37:8, pp.855-868.
60. *Ibid.* p.862.
61. *Ibid.*
62. More than one in ten of the deals funded through BA networks in 2000-2001 exceeded £250,000 (Mason, 2002; Mason and Harrison, 2003:863).
63. It was established as a 15 year limited partnership with funding from the European Investment Fund. In 1997 the Scottish Technology Fund was established as a joint venture with 3i. In 2000 Scottish Equity Partners was re-established as an independent investment management company and now invests across the UK. Scotland's support for business angels is also long-established with LINC Scotland being established in 1991.
64. Scottish Enterprise's other funds have recently been repackaged as co-investment funds. The Seed Fund will invest between £20,000 and £100,000 in businesses that have raised an equivalent amount from private sources (e.g. banks, angels). The Investment Fund invests between £0.5m and £2m on a co-investment basis in businesses that are sponsored by investors who have been approved as Deal Promoting Partners.

the gap in funding was less likely to be under £250,000, where informal but poorly co-ordinated investments by BAs operate, than between £250,000 and £1 million.

6. More recent schemes

The Devolved Assemblies in the UK (Scotland, Wales and Northern Ireland) also introduced their own equity support schemes using various kinds of matched funding and equity support measures. These are more varied than the schemes introduced in the *White Paper* and in some instances programmes (supported by additional European Commission finance) are able to make larger scale investments to attract firms to locate in specific regions.

In particular, public sector venture capital has had a long history in Scotland which now has more VC-backed companies than the rest of the UK. The Scottish Development Agency, (the predecessor to Scottish Enterprise) was set up in 1975 with an explicit investment arm. Scottish Development Finance was established in 1981 to make venture capital investments, with Scottish Equity Partnership established in the early 1990s to invest in SMEs in response to what was perceived as a market failure in the supply of early-stage venture capital.⁶³

The post-2000 technology crash prompted further state intervention, largely at the behest of the business angel community. This involved the creation of the Scottish Co-Investment Fund, launched in 2003 with financial support from the European Regional Development Fund. It invests alongside approved investment partners, most of which are angel groups. Any business that the investment partner has invested in that meets the scheme's eligibility rules can raise matching funds up to £1 million. To date the fund has made approximately 300 investments, investing £45 million alongside £95 million from the private sector.⁶⁴

Later hybrid funds include the Enterprise Capital Funds (ECFs) developed following a 2003 consultation where respondents highlighted that while funding had improved, a small and significant number of firms still faced funding difficulties. The consultation led to a US style SBIC-type scheme to increase the flow of capital to growth-orientated businesses seeking up to £2 million of equity investment.

The funds modify private investors' (regulated fund managers' and business angel syndicates')

risk-reward profiles and reduce the amount of capital they need to establish a viable fund. The government funds up to two thirds of the capital and addresses potential moral hazard issues by providing no downside protection. The government money acts as a loan that is repaid first, with 4.5 per cent interest. The scheme was investigated under EU state aid rules in May 2004 and gained Commission approval a year later in May 2005.

Interestingly, there is no maximum size for the funds and constraints on the amount that they can invest in a single business are limited. The government will only commit £25 million to a single fund or no more than double the private investment. To constrain investment within the funding gap, ECFs cannot invest in initial funding rounds that exceed £2 million, and they cannot invest more than £2 million in total, except to reduce dilution of their equity stake (and even then they cannot invest more than 10 per cent of their fund). Since the average fund is approximately £26 million in size, this still restricts funding to relatively small amounts. The scheme has now moved into a third round and an additional £150 million was recently announced for the scheme.

One of the interesting organisational innovations with the ECF has been its semi-privatisation of its operation. This is done through an arms length organisation *Capital For Enterprise Limited*, a company wholly owned by the Department for Business, Innovation and Skills.⁶⁵ The company acts as a consultancy and asset management business for the government and manages the loan guarantee schemes as well as hybrid VC programmes. The firm is a substantial investor in UK VC funds and its close connections to the government, together with its independence, enable it to avoid some of the conflicts of interest that plague public sector-run funds while still being responsive to government policy.

Given that many of the early schemes were developed during the technology bubble of the late 1990s (1997-2000) and were informed by New Economy ideas, it would be inappropriate to evaluate them solely on their original basis. Instead they will be evaluated against a) current academic understanding of the effective operation of hybrid VC funds, and b) the relative speed at which UK policy has improved compared to the 50 years it took the United States to build its own VC industry. Given the poor performance of similar schemes in other countries, a non-US comparison would set the performance bar too low.

7. Econometric analysis

This section presents the results of an econometric analysis of the effects of these strategic government interventions in the market for equity in smaller (particularly technology-driven) firms (please look in Appendix 2 for the full methodology). The interventions analysed are:

- Enterprise Capital Funds (ECF)
- Early Growth Funds (EGF)
- Regional Venture Capital Funds (RVCF)
- Scottish Enterprise Funds (SEF)
- University Challenge Funds (UCF)
- Welsh Hybrid Equity Funds (WF)

The evaluation integrated a quantitative variance study, exploring how variations in firms' inputs relate to variations in their outputs, and a qualitative process study examining the reasons for those variations. The inputs analysed include age, size, sector and funding type, while outputs are measured by standard accountancy variables including: trading performance (profitability and sales); capital structure (fixed assets, capital formation); factor utilisation (labour productivity); and survival. These were analysed as real, per capita and dynamic effects, as appropriate. The process study involved 20 interviews conducted in the UK, California and Europe.⁶⁶

The quantitative research had three primary aims:

- to compare the performance of UK companies that have received funding through these programmes against the performance of similarly matched companies that have not received such funding;
- to compare the performance of recipient companies dynamically before and after receiving initial investment; and
- to quantify the effects on business performance indicators of key variables including, for example, company age, size, sector and other controls.

The analysis involved applying robust econometric methods to a large panel dataset of 7,741 firms. These methods were used to

compare funded firms (782 treated, 10.5 per cent of total) with an untreated, matched control sample. This is an extremely powerful method for unpicking spurious correlations and identifying the specific effects of policy interventions, while controlling for other variables. For example, a funded firm may have an increase in a given performance variable. However, this improved performance may be because the firm is in a particular sector, or is a particular size, or is at a particular investment stage. The econometric methods allow us to separate out (control for) these other effects and produce a robust quantitative estimate of the treatment's effects alone.

The data covers the full sample of 782 firms backed by hybrid venture capital schemes found in the Library House data-base, a commercial dataset with comprehensive coverage of VC investments in the UK. This data was 'cleaned' by hand and then linked to financial information taken from the FAME database that provides standard accountancy variables taken from sampled firms' accounts.⁶⁷

7.1 General capacity building

One aim of equity investment schemes is to support general capacity building in firms that receive funding. This involves enhancing the resources that growth-oriented firms have at their disposal, whether capital for investment (proxied by net total assets per capita) or increasing the number and quality of their employees. While we lack data on the quality of employees, we can investigate increases in the number of employees and in capitalisation. When we compare the behaviour of funded firms through time against the control firms that were not funded by the schemes, we find that firms that received investment were characterised by a one-off upward shift in both employment and capitalisation.

The econometric methods allow us to quantify the effects. This is important as it matters a lot whether the effects are small, medium or large. The actual number of additional jobs created by all the 782 recipient firms was 1,407 more than would be expected without funding (or 1.8 extra jobs per firm). These findings suggest these schemes are better at producing employment than the EIS and VCT schemes.⁶⁸ Similarly, the scale of the capitalisation effect implies that 'treatment' (i.e. funded) firms have, on average, received £98,455.50 greater capitalisation than 'untreated' firms.⁶⁹

It is possible to explore this behaviour in more detail. More fine grained analysis, using a

65. BERR was subsumed into the Department for Business, Innovation and Skills in Spring 2009.

66. These involved both structured and semi-structured methods. Roughly half were conducted by telephone and half face to face. A broad coverage of interviewees was sought and those interviewed included fund managers from the main schemes, government policymakers, entrepreneurs that have received hybrid funding, private VC managers from both very large EU funds and smaller technology specialists, consultants, business angels, investment advisors, alternative investment fund managers and analysts, university technology transfer officers. Interviews were used to inform the process study and were used to build and test the framework. The qualitative study was triangulated using the results of a small questionnaire on the behaviour of early stage VC investors.

67. We are grateful to staff at BvDEP for their helpful support and assistance with data mining and collection.

68. The 'treatment' variable has a highly statistically significant and positive impact of employment (ln) with a coefficient of 0.587 (z-stat = 5.81, P>z=0.0001). The equivalent coefficients are 0.35 for EIS and 0.65 for VCT using similar modelling techniques.

69. Our preferred, random effects model finds that the 'treatment' variable is highly statistically significant and positive with a coefficient of 0.888 (z-stat = 4.95, P>z=0.0001).

growth specification model to investigate the time dynamics of this employment effect, reveals the curvi-linear relationship displayed in Figure 1.

This result suggests that employment growth in treated firms is more rapid in the years immediately after their initial equity investment. The majority of this employment effect is achieved by the seventh year, though our data is restricted to ten years and therefore we cannot explore subsequent behaviour. These results may reflect the weaker performance of the earlier schemes and care must be taken in making wider generalisations. While the schemes overall produce a positive effect on employment and are likely to produce high quality jobs, the size of the effect is relatively small, suggesting that these schemes are a relatively expensive means of short-term job creation.

The analysis also found that a number of controls had a statistically significant impact on capacity-building. Company size was negatively related to capital accumulation (but did not affect employment), manufacturing and construction firms had higher employment levels, and university spin-outs had both lower capitalisation (coefficient -2.42 , $z\text{-stat}=-4.57$) and employment when we control for age, sector, size and high-tech status. We also find

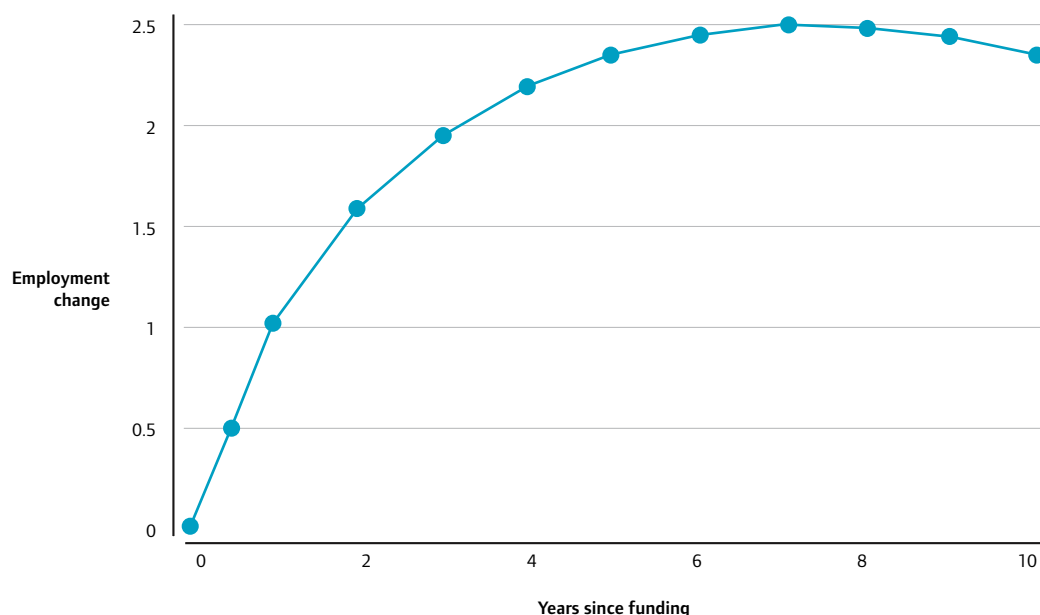
that high-tech firms have higher net total assets per capita (coefficient $.38$).

7.2 Profitability

Another aim of the schemes was to illustrate to investors that commercial returns could be achieved by investing in the funding gap. While valuation data on privately held firms is difficult to obtain and information on the returns that funds have generated cannot be obtained until the funds have closed, we can analyse profitability as a proxy for value to assess performance. If the schemes were illustrating very strong US-style levels of returns we would expect to see disproportionately higher profits and profit margins among funded firms compared to the untreated control sample.

On average, however, the six examined schemes have little impact on profit margins (i.e. the treatment variable is not statistically significant). In the previous 2008 evaluation of the EIS and VCT schemes the profit margins were found to decrease for EIS backed firms (coefficient -5.18), while no effect was found for VCT-funded firms. Such findings are not compatible with the view that the simple provision of equity funding will generate US-style VC performance. Nor it is compatible with the view that there is (was) a large untapped source of high potential firms in the UK that are only constrained from growing by a lack of funds at the levels funded by the schemes.

Figure 1: The proportional impact of funding on changes in employment over time since investment



Average effects can be misleading, however. When we estimate profit margins using a more nuanced treatment variable, which allows for differential effects as time elapses, we reveal an interesting time dynamic in the 'U shaped' relationship (see figure 2).⁷⁰ As figure 2 shows, there is a substantial, and immediate, collapse in gross profit margins by the sampled firms compared to the unfunded firms in the three years after receiving the initial investment. But, by the fourth year, gross profit margins have levelled out and by year six there is an equally dramatic increase in profit margins. This evidence is consistent with firms making a trade off between short-run growth and longer-term profit as they reconfigure and invest in new products, technologies and processes for future growth. Once these are all in place, firms are able rapidly to rebuild their profit margins. Such reconfiguring is likely to be especially important for new technology-based firms where technology life cycles are short and the need to innovate existing products/services in order to maintain sales and to ward off competitors is high.⁷¹

These findings are consistent with a constraint on funding for firms seeking to undertake 'equity style' behaviour. Government funding does have a statistically significant positive effect on firm behaviour and this behaviour follows the pattern it was intended to. While the limited data we have on the earliest funded

firms makes it difficult to statistically estimate future performance, the strong upward trend in gross profit margins is encouraging.

As with the previous models we also found that some controls were statistically significant. In particular, we find poorer profitability performance for university spin-outs (again) and larger firms, while service sectors were the most profitable. The size of the coefficient for university spin-outs impact on profit margins was very large and negative (-16.79, p. 0.075).⁷²

7.3 Labour productivity

A key economic role of US venture capital is the allocation of financial and managerial resources to help grow firms that will have a dramatic impact on productivity in the economy. When we compared the funded firms with the control sample we found that recipient firms do have higher average labour productivity (mean sales per employee measured in £'000s) than matched firms that did not receive funding from the schemes being evaluated. In the first instance, this was identified as a one-off, upward shift in per capita labour productivity for supported firms, over and above that achieved by unsupported firms. After controlling for other influences, in the 'typical' supported firm this would equate to £57,800 (sales per worker) in increased labour productivity.

70. This involves using a non-linear approach that incorporates both the natural log of time elapsed and its square to produce the 'J curve' in figure 2. To rule out the possibility that the improved performance is a 'blip' in an otherwise downward trend, we also estimated a cubic term and find that it is not statistically significant.

71. Burgel, O., Fier, A., Licht, G. And Murray, G.C. (2004) The Internationalization of Young High-Tech Firms. 'ZEW Economic Studies.' 22. Mannheim: Physica-Verlag.

72. This former finding would support Lockett and Wright (2005) who find frequent limitations in the managerial capabilities of European technology transfer offices.

Figure 2: Gross profit margins over time since investment

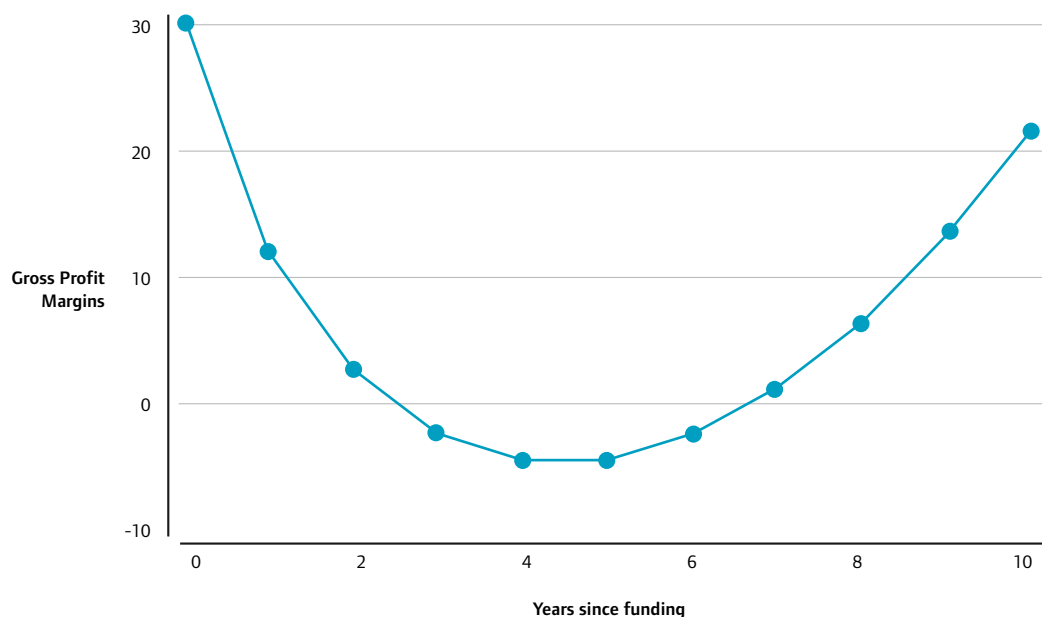


Table 1: Results summary (random and fixed effects coefficients)

	(log) Real Sales per Capita Profits		(log) Real Operating per Capita		(log) Real Capitalisation per Capita		(log) Employment		Profit Margins	
	RE	FE	RE	FE	RE	FE	RE	FE	RE	FE
Treatment Variable	0.37*	0.48**	0.56	0.55	0.89**	0.94***	0.59***	0.59***	-0.55	-1.86
(log) Years since investment	-0.87***		-1.07***		-0.33		-0.07		-23.43***	
Years since investment squared	52.75*		73.91**		85.31*		44.35		1976.37***	
(log) Size	0.03	-0.13***	-0.22***	-0.45***	-0.71***	-0.81***			-4.26***	-5.46***

This result (coefficient 0.37) is similar to the recent results of the evaluation of the EIS and VCT schemes⁷³ where the coefficients were also positive and of a similar size (0.33) for EIS though larger for the VCT scheme (0.74).⁷⁴ Again, using more subtle analysis we find evidence that the full effect is more nuanced with a decline in labour productivity immediately post-investment and a rebound around four years later with strong predicted growth thereafter. Again, such a pattern would support a trade-off between capacity building and short-term sales and profitability by innovative young firms.

This has important implications. UK government support for equity investment has been justified in terms of a market failure. Specifically a market failure in the provision of equity finance within the funding gap. Policy has been based on the assumption that if funding is provided then high potential firms being held back by (only) a lack of funding will be able to achieve their full potential. The current solutions on offer have not (to date) produced the disproportionately higher performance firms seen in US VCs' early-stage investment portfolios. Whatever problems UK firms have, they are more complex than a lack of funding alone.

Secondly, we do also find in more detailed analysis repeated and encouraging evidence of the kinds of growth-oriented behaviour that the schemes were intended to stimulate. The data show that firms engage in disruptive (asset development) behaviour that lowers short-term performance while generating longer-term improvements. Given that the results of this positive behaviour take many years to become apparent, early evaluations of schemes (with less than a decade or more of comparative data) may therefore produce misleadingly negative findings if the full consequences of the additional public-supported investments have not yet been realised.

This difference in the behaviour of funded firms and the control sample suggests that the supply of risk equity is constrained in some way. Two further pieces of evidence support the suggestions that this behaviour indicates a supply side problem. First, large numbers of portfolio firms received further funding from

73. Cowling, M., Bates, P., Jagger, N. and Murray, G. (2008) 'Study of the impact of the Enterprise Investment Scheme (EIS) and Venture Capital Trusts (VCTs) on company performance.' London: HMT.

74. Our preferred random effects model finds the 'treatment' variable is statistically significant (at the 10 per cent level) and positive with a coefficient of 0.368 (z-stat = 1.90, P>z=0.057).

8. Designing policy to support VC

Two findings stand out in our analysis (summarised in table 1). First, while we do find evidence of a selection effect (i.e. a change in behaviour and performance as a result of being funded by the schemes), the size of that effect to date is modest. This result is in line with our previous analysis of the EIS and VCT schemes. Subject to the caveats noted earlier, *companies that are recipients of funding under one or more of the government hybrid funding schemes examined do not yet exhibit significantly better performance*. This suggests that the UK does not possess an untapped resource of high potential firms whose (greater) performance will be unleashed by simply making available more equity finance within the 'equity gap'. Moreover, it shows that the New Economy expectations that underpinned the development of government policy in the late 1990s were unrealistic.

private sector VC funds. Roughly a quarter of the sample of treated firms received a third round of funding (many of the hybrid schemes invested only in the first two rounds). This is very substantially higher than would be expected if these were typical firms, particularly given that the average age of the firms in the treated sample is only 4.1 years. Secondly, there is a threshold effect. Below a total investment threshold of approximately £1 million little effect is observed. Firms may be using these smaller sums of money as operating capital. Conversely, this limited effect may reflect that hybrid funds are competing with Business Angels at the levels where there is limited evidence of an existing lack of supply of funding.

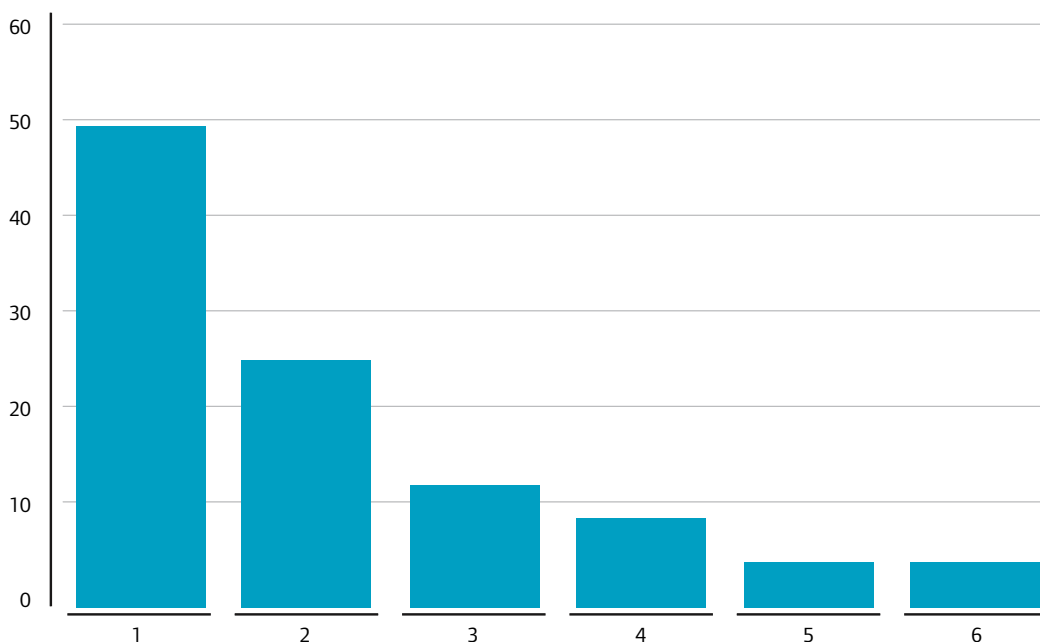
Together these findings suggest that rather than only a finance-gap problem that can be solved by simply filling the gap with public money, or only a demand side problem caused by poor quality firms, the UK suffers from a 'thin market' in the provision of specialised venture capital funding and managerial expertise. 'Thin markets' occur when small numbers of high potential firms and small numbers of investors with the skills to help them grow find it difficult to find one another without incurring unacceptable transaction and/or search costs. As a result, firms complain

about difficulties in getting funding while investors bemoan the difficulties in finding attractive portfolio firms. In a thin market both entrepreneurs and investors are telling the truth. Because thin markets make it difficult for the supply and demand for finance to match they reduce overall levels of investment.

Within such a system, simply adding more money is unlikely to be sufficient as an informed policy response. A number of other conditions also need to be put in place. Above all, there needs to be demand for funding from high quality firms. Without a steady stream of high potential 'investment ready' firms, additional investment is likely to be allocated to lower quality firms. Similarly increasing the 'demand side' alone, for example, by producing more university spin-outs and start-ups, is unlikely to produce the impact on the economy seen in the US unless finance is available and there are experienced managers in the funds and firms able to grow them into high value assets. Other challenges include addressing the co-ordination problems that thin markets create between entrepreneurs and investors or resolving other constraints, including red tape and access to managerial labour markets, that prevent a firm growing fast enough to generate the high returns that investors require.

75. It is important to note that the data used in this histogram is skewed to the portfolio firms of more recent funds. It would be expected that more firms receive multiple rounds of finance over the life of the fund.

Figure 3: Percentage of portfolio firms receiving different numbers of funding rounds⁷⁵



Understanding how and why 'thin markets' occur, and what can be done to address them, requires us to understand why there are problems with both supply and demand. This requires attention to the simultaneity problems involved in operating a fragile, co-ordinated VC funding system over long periods of time. The following sections integrate the results of this quantitative variance study with results of the qualitative process study. They show how the matching of the supply and demand of VC funding to firms depends on a complex organisational system that must work simultaneously for some time before it becomes effective.

9. The venture capital system

The most important institution within the venture capital system are the VC funds. With such funds one thing is clear – scale matters. In general, early-stage VC funds below £25–30 million generate poorer returns for investors.⁷⁶ The minimum size will be greater in funds specialising in sectors, such as biotech, where larger investments over longer periods are needed. While small funds often have limited resources to spend on finding, evaluating and supporting investee firms, their main problem lies in their inability to provide significant follow-on finance to successful companies. This results in their investment position and future returns being diluted by deeper pocketed co-investors. If the further financing requirements of the portfolio company are large in relation to the fund's size, this dilution process can be financially penal to the original investors in the fund.⁷⁷

Small funds also have a number of other problems. They find it difficult to spread their risks widely across a number of portfolio firms which is problematic because the majority of the returns in a portfolio come from a small number of very high performance investments. In order to stand a good chance of capturing one of these investments a syndicated portfolio needs to have at least 8–10 investments, while a portfolio closer to 20–30 investments would more adequately spread their risks. Small funds therefore find it very difficult to spread their risks while making follow-on investments.

Small funds are also disproportionately hurt by high fixed costs. This problem was dramatically highlighted in the operation of the EU Seed Capital Fund Scheme in the early 1990s, where the prevailing small fund size meant

that a number of funds would exhaust their investment capital in less than five years *even if they did not make any investments*.⁷⁸ Smaller funds are further disadvantaged because they often specialise in making earlier stage investments. While such immature enterprises often do not need large amounts of external finance initially, they are often more costly to manage and need to be nurtured over a long period before they can achieve an attractive market exit.

Scale also influences the business models and paths of development that firms can use. Economic advantage comes from having a larger income, and that is a function of the scale of investment (funds under management) and average profitability.⁷⁹ Accordingly, funds can adopt business models that either increase the size of investments for a given level of profitability or increase profitability for a given size of investment.⁸⁰

The first business model focuses on increasing the total sum of funds under management with a corresponding increase in their average investment size over time. This allows funds to take advantages of the benefits of scale when managing the risks of equity investment. This acquisitive behaviour often leads to 'style drift' where funds move away from early-stage investments towards larger, later stage, management buyout-related investments.⁸¹ The dominant public policy concern in the UK regarding the financing of high-growth young firms has been that, as VC firms follow this strategy, they move out of early-stage investing. This 'drift' thereby creates a funding gap as early-stage activity is abandoned.

However, in the United States, as individual VC funds get bigger they do not necessarily move out of early-stage investing in new technology. Rather they use the scale of their funds to make initial and repeated follow-on investments across a portfolio of interesting firms and technologies.⁸² The majority of successful seed activity in the US is undertaken by integrated venture capital funds, each managing in excess of a billion dollars.⁸³ They do this because they adopt a second business model that involves increasing the profitability of investments. Accordingly, they attempt to make a number of extremely high return investments (often producing returns 20 or 30 times their original investment) that are large enough to cover the costs of the majority of less successful investments or failures. This requires technically and commercially well-informed fund managers to become

76. Murray, G.C. and Marriott, R. (1998) Why has the Investment Performance of Technology-Specialist, European Venture Capital Funds been so Poor? 'Research Policy,' 27, pp.947–976; and Jääskeläinen, M., Maula, M.V.J., and Murray, G. (2007) Profit Distribution and Compensation Structures in Publicly and Privately Funded Hybrid Venture Capital Funds. 'Research Policy,' 36(7), pp.913–929.
77. In the United States 'pay to play' provisions in anti-dilution clauses can mean that investors who are unable to follow on into the next round of funding will see the value of their investment fall as new investors are able to buy in at a lower cost.
78. Murray, G.C. and Marriott, R. (1998) Why has the Investment Performance of Technology-Specialist, European Venture Capital Funds been so Poor? 'Research Policy,' 27, pp.947–976; Mason, C.M. and Harrison, R.T. (2003) Closing the Regional Equity Gap? A Critique of the Department of Trade and Industry's Regional Venture Capital Funds Initiative. 'Regional Studies,' 37:8, pp.855–868.
79. The general partners of a fund receive an annual income as a proportion of the funds under management as well as sharing in the capital gain ('the carry') of the overall fund. *Ceteris paribus*, a large fund is likely to increase their rewards from both sources of income.
80. Institutional investors prefer funds with well established and clear business models and corporate governance structures. These are often distorted by 'multi-play' investment strategies.
81. Sohl, J.E. (2003) The private equity market in the USA: lessons from volatility. 'Venture Capital,' 5 (1), pp.29–46; Bygrave, W.D. and Timmons, J.A. (1992) 'Venture Capital at the Crossroad.' Cambridge, MA: Harvard Business School Press.
82. Dimov, D.P. and Murray, G.C. (2006) An examination of the incidence and scale of seed capital investments by venture capital firms, 1962–2002. 'Small Business Economics,' 18(1–3), pp.13–40.

very actively involved in developing, growing and nurturing young firms. Their overriding objectives are to identify major technological opportunities, create new assets, and build them into outstanding portfolio firms that can be sold for substantial profit.⁸⁴

10. Business models and the VC system

The decision of which business model to follow is influenced by idiosyncratic factors as well as by the current institutional and economic environments. Because the profitability-focused business model is higher risk and more fragile, it requires several components of an overall financing system to be in place and to work in a co-ordinated fashion. When these components are not working together effectively, fund managers following a high-risk profitability-focused business model will be forced to default back to a lower risk, size-focused business model. This was seen, for example, after institutional investors stopped investing in technology-focused VC funds after the losses of the dot.com bubble.

The component parts of a functioning venture capital cycle include:

- A steady stream of **funding** from investors prepared to take on the higher risks involved provided sufficient returns can be generated.
- A supply of **high quality, high potential firms worthy of investment**. The number of firms with high enough potential growth rates to generate the sorts of returns that VC funds seek is likely to be very small relative to the number of start-ups in an economy. However, the supply needs to be large enough to sustain an industry. Since firms following profitability-focused business models are typically specialised, they may require a larger pool of firms than generalist investors. These firms can be either concentrated in one place (like Silicon Valley) or spread over an entire continent. Such firms also need to be investment-ready. In this regard, Business Angels can play important roles by building high potential firms for VCs to take on and grow.
- The availability of **knowledgeable and well resourced venture capital firms** which can effectively act as co-ordinating agents between investors and entrepreneurs. Venture capital funds act as the main nodes in the complex nexus of contracts that links

the actors in the venture capital system together.⁸⁵ They supply the skills and funding needed to create and grow viable firms. These skills are in very short supply but are essential for the system to work effectively. Since these skills are based on experience, this creates a 'chicken and egg' problem, as skills are needed to operate an effective funding system and an effective funding system is needed to provide the environment where skills can be built up. This is one reason why government support has been so important to human capital development in so many international VC industries.

- **A supportive environment for high-growth firms**. This covers the institutional environment where firms operate and the combined expertise of the firm's managers and the network of advisors and industry contacts that help growing firms. VC funds draw on an external (and expensive) infrastructure of lawyers, accountants and consultants. This critical information resource network is more difficult to sustain when markets are thin and demand reduced. As markets develop and thicken, improvements in this infrastructure can generate 'increasing returns' that support future investment by making subsequent investments easier and cheaper.
- Finally, there need to be **viable exit routes** that will realise the value of investments and generate large enough returns for investors to justify the higher risks involved. A profitability-focused business model requires a choice of flourishing and liquid exit markets including both a stock market conducive to VC exits and a strong trade-sale market.

When all the parts of this system are working effectively it can generate a self-sustainable cycle. Here, venture capital firms demonstrate high performance returns to institutional investors which reinvest in new venture capital funds that are deployed to the next wave of entrepreneurial innovations. This encourages entrepreneurs to build high potential firms and seek funding. The few firms that are then funded provide learning environments for their managers and VCs, helping to further strengthen the system.

However, the system can be very fragile as it suffers from 'simultaneity problems'⁸⁶ given that all the elements of the system must each be present and able to work together over long periods of time in order to sustain fragile, often complex, profitability-focused

83. Ibid.

84. This discussion of business models draws heavily on work by Prof. Ed Steinmeuller (Sussex).

85. Gompers, P. and Lerner, J. (2001) The Venture Capital Revolution. *Journal of Economic Perspectives*, 15:2, pp.145-168.

86. Gilson, R.J. (2003) Engineering a venture capital market: Lessons from the American experience. *Stanford Law Review*, Vol. 55, pp.1,067-1,103.

investment strategies. Shocks to the system, such as the dot.com crash or the current global credit crunch that constrain investment and disrupt an orderly exit market can imperil its stability. Evidence of such disruption can presently be observed in the difficulties that even elite upper quartile US venture capital funds are having in generating high value exits in the current economic climate of 2009. This has profound effects on the costs of their investments, the time they are held, the performance of the funds, and – above all – the willingness of institutional investors to continue to support venture capital as an attractive asset class.

In the UK, this system has not yet become self sustaining – hence the thin market problem. Much government policy has focused on supporting a steady stream of funding. But other, arguably more important, parts of the system, such as improving the specialised human capital of the industry and increasing the flow of high-growth potential firms, also need to be addressed. In assessing government policy, it is important to look at how policies contribute towards the effective operation of this system. The next section runs through the components of the system and assesses their impact.

11. Assessing recent government policy

11.1 Regional equity

When analysing the influence of geographic region on the distribution of funds, we found that with the exception of the South East, where levels of funding were higher, we do not find that regions have a statistically significant effect. This suggests the schemes have been effective in their intention to reduce regional inequalities in the provision of equity funding.

11.2 Funding

Funding has some positive impacts.

Interviewees suggest the clear signal that the policies send about the UK being a supportive environment for VC investment has encouraged confidence in the sector. The conditional linking of public money to private money and the specific early-stage focus of the schemes in activities poorly covered by the private sector, suggests that the schemes are not likely to have ‘crowded out’ private money. Similarly, the large number of investments that have received additional rounds of private VC funding (approximately 25 per cent received three or more rounds) suggests the

schemes may provide important ‘certification’ information to private investors making follow on investments.

But the assumptions about funding were over-optimistic. It is also clear that the initial expectations by policymakers that these schemes would show the investment community that attractive risk-adjusted returns could be made from early-stage VC investments reflected a degree of over-optimism. The key challenge for early-stage VC in the UK continues to be the lack of investment caused by the poor returns generated by some though not all funds. In the dot.com bubble of the late 1990s it was assumed that institutional investors were badly informed and early-stage VC investment returns were consistently high. Hindsight suggests that the opposite is the case: investors are well informed and average returns are often low. However, averages can be very misleading. The returns from the top performing early-stage funds operating in the UK (though not necessarily based in the UK) are high and such funds are often *oversubscribed*. The *constraint on their expansion is not funding*, as their investors would like to invest more. Instead, they are unable to expand because of human capital constraints in the industry and the structural difficulties of increasing the size of the partnerships. This again highlights the importance of building human capital in the sector and paying attention to the skewed distributions when designing policy.

Funds were also poorly targeted. Many funds were focused under £200,000 where they directly overlapped with the investments of Business Angels and Business Angel networks.⁸⁷ At the time, investors at this level were complaining of too much money and not enough good firms to invest in.⁸⁸ The threshold effects we pick up in our data, where we find no difference between the treated sample and the control sample for small levels of total investment, supports Mason’s concerns about the constraints on funding being at higher levels (between £250,000 and £1 million) than was thought when the policies were designed.

Focusing on a single ‘funding gap’ may also miss the importance of multiple gaps.

As firms grow, different sized tranches of finance are needed over time that may not be willingly funded by the market.⁸⁹ Funding firms at the early-stage may resolve initial funding problems without addressing the greater need for an effective funding escalator to be available to all attractive, growth oriented

87. Mason, C. (2002) ‘Report on Business Angel investment activity 2000-2001.’ Glasgow: Hunter Centre for Entrepreneurship at Strathclyde on behalf of National Business Angels Network and British Venture Capital Association, London; Mason, C.M. and Harrison, R.T. (2003) Closing the Regional Equity Gap? A Critique of the Department of Trade and Industry’s Regional Venture Capital Funds Initiative. ‘Regional Studies.’ 1360-0591, 37:8, pp.855-868.
88. Mason, C.M. and Harrison, R.T. (2003) Closing the Regional Equity Gap? A Critique of the Department of Trade and Industry’s Regional Venture Capital Funds Initiative. ‘Regional Studies.’ 1360-0591, 37:8, pp.855-868.
89. Murray, G.C. (1994) The Second Equity Gap: Exit problems for Seed & Early Stage Venture Capitalists and their Investee Companies. ‘International Small Business Journal.’ Vol. 12, pp.59-76.

young firms. The end result may simply be to set firms up to fail at a later date.

Finally, in a world of skewed distributions, how and where funds are invested is often more important than how much is invested. Many similar schemes in other countries have had funding allocations influenced by political decision makers. As a result, investment decisions are distorted and performance has been poor. If funds are intended to generate commercial returns the historical record suggests funding decisions should be kept at arms length from politics. Here we also find encouraging evidence. The UK government has produced an innovative organisational arrangement for allocating funds by setting up *Capital For Enterprise Limited*. The creation of an arms-length public body staffed by both professional financial staff and ex-civil servants allows commercial decision making to take place without political interference while retaining government access to valuable knowledge. While it is too soon to evaluate CfEL, this initiative appears a timely and intelligent response to the problem of civil servants increasingly having to act as commercial fund managers in the governance of public investment in the hybrid VC funds.

11.3 Large, well funded, knowledgeable VC funds

Hindsight also suggests that some of the earlier public supported VC focused support schemes were subscale. It was overly ambitious to expect some like the UCFs, to become self sustaining given their structural limitations. The average RVCF was £27 million, the average EGF just over £5 million, while the UCFs had just over £3 million each. The ECFs range in size from £10 million to £30 million with an average of £26 million. In each programme, the small size of the funds limits both their potential and their performance. However, lessons do appear to have been learnt. More recent funds tend to approach minimum levels of commercial viability. However, any deviations from this upward trend would be unwelcome.

Perhaps a bigger viability issue is the unintended consequences of constraining the funds' investment strategy within the equity gap. For example, the RVCFs could only invest up to £660k, the EGFs up to £200k, the UCFs up to £200k. These severe constraints on the maximum size of investments to a single company can force funds to make more investments than can be effectively supported.⁹⁰ Profitability-focused business models require VCs to be very actively involved

in growing their portfolio firms. Constraints on this involvement hamper both the firm's development and the accumulation of knowledge within the fund's management team. More significantly, the inability to engage fully in larger follow-on funding means that small funds' investments get further diluted in each subsequent investment round. Such constraints hamper performance and make it harder to demonstrate the commercial attractiveness of early-stage VC investments (a key government objective).

11.4 High quality deal flow and human capital development

The small size of the impact of these funding schemes to date suggests ex post that many of the schemes invested in firms that were not of sufficient commercial potential. The RVCFs only invested in 48 of the first 2,680 applications they received, further indicating major problems with the quality of deal-flow attracted by the programmes (Murray, 2008; Mason and Harrison 2003). While we find encouraging evidence of policy learning in the recognition of this problem⁹¹ the analysis suggests *the key policy issue has been and remains how to generate more exceptionally high-potential firms.*⁹²

Introducing policies to improve the quality of firms seeking funding could generate a bottomless pit of funding requests. This could be avoided by being extremely selective. For example, by only supporting firms with strong management teams with prior experience of successfully floating or selling a firm; investing in sectors where growth rates and innovative potential are higher; and only supporting entrepreneurs who have 'good predictors' of success, such as many years previous managerial experience in the same sector and proven entrepreneurial ability. Rigorous selection criteria are characteristic of all successful VC funds.

Ensuring a good 'deal flow' of such high-quality firms is important as VCs learn how to operate a profitability-focused business model through experience. Much of this knowledge is technology or sector-specific and the most successful American investors specialise by sector, or in a few technology platforms within a sector. Specialisation, as noted above, narrows the pool from which firms can be selected while increasing the potential for informed selection practices. As a result, VC funds that are tied to a region are not only constrained in the number of high potential firms they can invest in, they are also drastically

90. In the standard VC model, the fund manager needs to make the majority of first investments within the first 3 to 4 years of a ten year fund. Subsequent follow-on investments need to be made sufficiently early to ensure that the fund can exit its portfolio of investee firms by the tenth year.

91. HMT/SBS (2003) 'Bridging the finance gap: next steps in improving access to growth capital for small businesses.' London: HM Treasury and Small Business Service. pp.6, 33.

92. This lack of good quality firms is supported by the research undertaken by an EPSRC project on Financial and Organizational Innovation in High Technology Firms. This project found that many high-growth start-ups lacked significant management, and that the gap was made up in large part by working boards of directors and active support by expert advisors. This network of help contrasts with US counterparts funded by US-VCs that typically have strong internal management seconded by their backers.

constrained in their commercial ability to specialise by sector or technology.

This lesson has been learnt quickly, and the Early Growth Funds that started shortly after the RVCFs have both a regional and national focus. This suggests there is a tension between regional policy and the need for technological or sectoral specialisation by commercially-focused VC funds. England's nine Regional Development Authorities have entirely legitimate desires to have ready access to a local pool of venture capital. But such regional specialisation, outside areas where there is a very high concentration of suitable firms, is likely to produce venture capital funds that lack the specialised knowledge or opportunities that are needed to produce high performance investments. Business angel networks with their wider spectrum of investor preferences may be more suitable vehicles for a regional policy which is complementary to more nationally focused, specialist VC funds. Government co-funding is reported by interviewees to have played an important role in professionalising and supporting more organised regional business angel networks and training future generations of investment managers.

suggest that because government policy has focused on narrow funding gaps, it has missed the problems this generates for firms in sectors (such as biotechnology) that require repeated rounds of financing. As Figure 4 shows, when schemes are introduced to fill specific vertical gaps in funding, they also as a consequence introduce organisational barriers that firms need to cross as they grow and seek additional funding.⁹³

Subsequent funding events that require the search for new investors can have a disruptive effect on firm growth. They require firms to identify new funders, negotiate a sale of equity ownership and re-orientate the firm towards the next round of funding. Such institutional barriers can therefore create substantial costs and increase the time it takes to grow a viable firm. These barriers can have the consequence of reducing the firms' final valuation, making a profit-focused business model more difficult to operate. Perhaps the largest cost of the existence of multiple schemes is the opportunity cost to the entrepreneur. For many high potential young firms, time and managerial resources are as important constraints as finance. The need to negotiate finance from a range of programmes over time is a cost not faced by entrepreneurs supported by the largest private funds.

93. The report from Dr Samantha Sharpe of the Centre for Business Research, Cambridge ('Start-up finance: The role of Micro Funds in the financing of new technology based firms', produced for NESTA in May 2009) makes a similar point regarding the costs associated with micro funds.

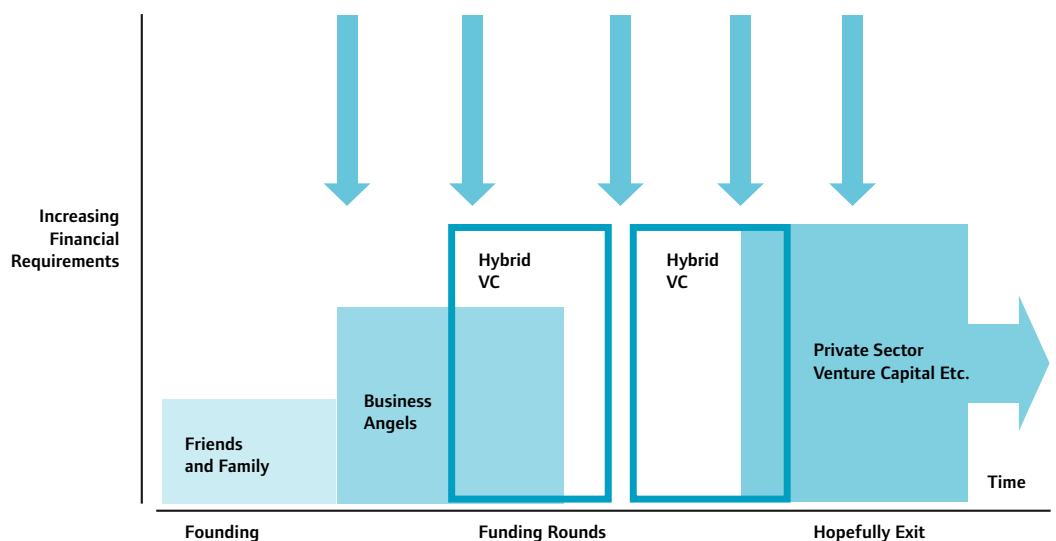
11.5 A supportive environment for growing firms

The UK has problems growing new assets into viable, high value firms of the sort produced by VCs in the United States. There are many reasons why this is difficult. Interviewees

11.6 High value exits and stable co-ordination

The last area where environmental factors influence the viability of classic venture

Figure 4: Organisational barriers to growth generated by vertical funding schemes



capital business models relates to the ability to achieve high value exits. Under normal economic conditions, the UK has a very supportive market for trade sales, but lacks a VC-focused stock market comparable to NASDAQ. While AIM, the London Stock Exchange's international market for smaller growing companies, does provide flotations, these are often viewed by growth oriented firms and their corporate advisers as a source of additional finance rather than as a final exit. At the moment, even this exit has been closed, something which threatens the stability of a system which is highly sensitive to the time cost of investment. Regardless of the means by which a VC fund is structured or financed, a serious constriction on the opportunity to exit individual investments via market flotations or trade sales is arguably the single biggest short run break on VC activity. It impacts profoundly on both fund raising and investment as was seen by US and UK VC activity in 2008-9.

12. Conclusion

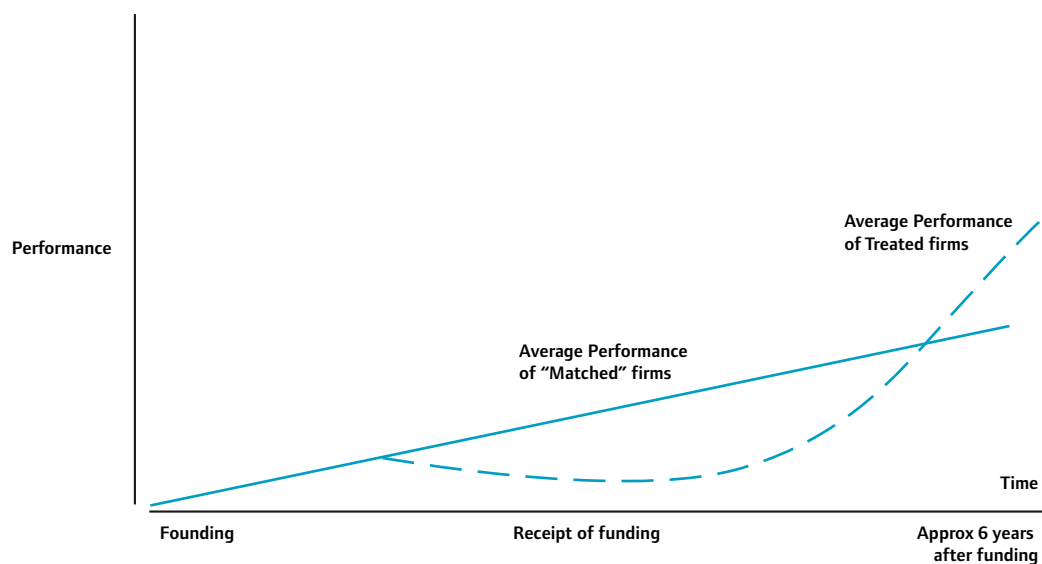
A more sophisticated modelling exercise using data that will not be available for many years would be needed to analyse the full impact of these schemes. Our analysis has produced a number of encouraging findings and clear evidence of policy learning. It is particularly encouraging to note that because the majority of the data are drawn from the earlier (more constrained) schemes, one might

expect superior performance from more recent schemes in future evaluations. This would reflect more informed government policy and greater hybrid VC fund management experience.

The analysis found that the programmes' funding had a clear impact on recipients firms' performance over time when the treated firms were compared to control firms. The evidence from a range of standard accountancy metrics suggests that treated firms forgo immediate financial performance while capabilities and assets are built up to increase future competitiveness. The result of this capability building, a form of investment behaviour encouraged by VC investors, indicates that over time the treated firms have the potential to exceed the performance of matched firms which have not undertaken such investments. The robustness and longevity of the performance premium gained by the treated firms will not be able to be fully ascertained for a number of years because data do not exist at this time.

The econometric modelling shows a turning point where the funded firms start to outperform the unfunded matched firms (this is schematically represented in Figure 5). While the performance results to date may appear modest, it is worth noting that it is common for independent econometric evaluations of government support schemes to find no tangible or material positive outcomes. In some instances programmes that have existed

Figure 5: Comparative performance of treated and untreated firms through time



for many years and have spent considerable amounts of public money generate negative impacts. That these hybrid schemes have shown a positive outcome over a relatively short period – let alone in many instances they have outperformed established schemes such as EIS – should be seen as substantive grounds for optimism.

All the same, the analysis and interviews do suggest that young UK firms face very real problems in raising equity finance for early-stage development. The analysis suggests that these difficulties are unlikely to be caused purely by a market failure in the supply of capital. Instead, the small overall selection effect and the equity style behaviour we find when firms are funded above a threshold, suggest there is a thin market in the simultaneous supply of critical resources including finance, managerial expertise (in both recipient firms and VC funds) and high-quality, investment-ready firms.

Conceptualising the small-firm equity-finance problem in terms of ‘thin markets’ would produce a more systemic framework for developing future entrepreneurial policy than only focusing on the supply of funding. This more holistic market perspective would draw attention to the simultaneity problems associated with building a funding system of many complex component parts. In doing so, it would address both demand and supply side problems (including issues of managerial expertise), whilst still allowing public policy to be justified in terms of market failure. In essence, the problem of thin markets and the simultaneity problem are the same – they both address a situation in which the co-ordination of supply and demand is made difficult because it is mediated in highly uncertain, complex markets comprised of a range of different institutions. Such markets are demanding because they are knowledge intensive and have to operate over long periods of time (10-year funding cycles) before clear results on performance are available.

Under such conditions, a key issue relates to the long time that is needed to build up managerial capabilities in both funds and firms. This suggests a shift in emphasis towards encouraging firm growth, (and building up the human capital needed to grow high impact firms in both VC funds and investee firms), rather than firm formation. The performance data cast severe doubt on the wisdom of unfocused policy to support greater firm foundation without paying attention to the

quality of the firms and the quality of the support they can receive. This conclusion is not novel. A number of academic observers, for example Acs, Audretsch, Shane, Vivarelli and Storey and several others have argued the case for a revised policy focused on high potential firms rather than merely increasing the number of new start-ups. We know empirically and theoretically that most start-ups die quickly and have little net impact on the economy.

Building on these findings, and after seeking both practitioner and academic feedback on the research via a series of workshops run at Cass Business School, a number of policy suggestions emerge.

Hybrid venture capital funds should be larger. Small funds are often unviable and have insufficient financial resources to cover their high fixed costs (especially expert management), diversify their portfolios or provide the follow-on funding to the most promising investments in their portfolios. Small funds are therefore very vulnerable to a dilution of limited partners’ investment returns. The minimum size of a fund is the subject of intense debate. However, circa £50 million is probably the minimum size that can be expected to be viable. Early-stage VC funds and funds specialising in life sciences and clean tech should preferably be larger. Regardless, the fund should have sufficient scale to manage a fully diversified portfolio of investee firms (with at least 20 enterprises) and to take the minority of high performing firms in its portfolio through the several rounds of financing necessary for a successful IPO or trade sale exit.

Venture capital funds with a commercial focus need to be able to select their investments from a large pool of high quality firms. Constraining funds to invest in geographically mandated areas is likely to have a negative impact on the size of the pool of firms they can invest in. This will limit their ability to specialise and generate commercial returns. There is therefore a potential tension between regional policy and innovation policy. To constrain investment in new technologies to a sub-national focus, and outside international centres of excellence, is particularly problematic. Regions primarily defined by local historical identities and/or political administration are almost invariably too small to generate the number of high quality firms needed to ensure a fund can make attractive commercial returns. Successful VC funds are usually specialist and organised on an

increasingly international and even global basis. These long run commercial imperatives need to be accommodated rather than frustrated by policy interventions.

The operational constraints that keep publicly funded VC funds operating within the 'funding gap' also generate significant costs. Many schemes constrain investment size and focus to ensure that government funds provide the small sums of risk capital that are not available from private VC funds. Constraints in investment size are imposed in order to ensure that the earliest and smallest tranches of finance remain available through public intervention. However, this attempt to stop hybrid VC funds drifting towards exclusively larger deals has a major cost. It prevents funds operating in a commercially effective manner and 'following-on' their investments in high potential portfolio companies through syndicating with later stage VC funds. This has a negative effect on the investee businesses, as a 'drip feed' of finance means that the entrepreneur's time is spent searching for the next round of funding (that may not be available) rather than growing the business. These constraints imposed by the public funders of hybrid programmes might need to be less rigorously applied if business angel network investment activity was increased, thereby providing more supply at the earliest stages of external finance.

Policy that focuses on filling narrow funding gaps can be counter-productive. Policies that fill 'vertical' gaps in finance by the specific provision of funds that address different levels of investment (e.g. maximum investment levels per portfolio firm of £50,000; £250,000 and £2 million) can create artificial barriers between successive funding schemes that force growing firms to undertake disruptive and costly changes in their search for new or additional investors. This constrains firm growth, particularly in highly competitive new or immature markets, and reduces investors' returns. The onus of substantial transaction costs in dealing with multiple fund investors is not present for a portfolio firm that has the support of a sizeable commercial fund that can provide multiple financing rounds. Policy should focus on improving the flow of funding to high potential, growth oriented firms (through a 'funding escalator') as they move from formation to a successful market exit.

The systemic approach to policymaking adopted by the UK government that encourages Business Angel networks and

links entrepreneurship and innovation policy is a positive development. Business Angels play an increasingly important role in early-stage investment and have the potential to complement later stage VC investment. As with VC funds, their performance is highly skewed, but many are increasingly capable of building exceptional firms that can then be taken on by venture capitalists. The best Angel networks are now able to work directly with venture capitalists in order to provide a 'funding ladder' for high potential SMEs. Business Angel networks are often very local and highly 'hands on'. Therefore, they have the potential to support regional development ambitions without compromising their own economic viability.

While the UK has not yet produced an early-stage VC funding system comparable with the best available in the United States, we do find encouraging evidence of change.

It was never realistic to expect the UK to produce a US-style system after just a decade of specific public intervention. Learning how to produce such a system comes from sustained long-term experimentation and experience. None the less, the UK has engaged in a range of innovative experiments. These initiatives should be recognised and commended. While the data clearly shows there are major problems, even some of the early schemes that were constrained from operating as commercial VC investors have generated encouraging equity-style behaviour in the firms they have funded. The rapid and effective policy changes that have occurred as a result of lessons learnt from these hybrid schemes suggests that there exists a growing body of professional knowledge and (crucially) experience in both the private and the public sectors. Therefore, we have good reason to expect more positive outcomes in the future from hybrid VC programmes. Our optimism is conditional and assumes such programmes have an economic/commercial modus operandi and are focused on exceptional and internationally competitive technology, intellectual property, entrepreneurs and businesses without regional constraints.

Appendix 1: Summary data on sampled firms by hybrid programme

Table 2: Summary data on sampled firms by hybrid programme

Portfolio Firms Information	Multiple funds involved	Welsh	Scottish	UCF	RVCF	EGF	ECF	
Standard industrial classification:								
Primary/mfg/construction	10.3	26.2	19.8	15.1	18.1	19.5	10.7	
Service sector	89.7	73.8	80.2	84.9	81.9	80.5	89.3	
								Average
Median firm age (years from incorporation to 1st equity investment)	4	3	3	4	2	2	3	3
High tech (per cent) (i.e. Butchart definition)	21.3	28.6	33.6	60.5	42.9	24.8	10.7	34.3
Acquired (per cent)	5.9	7.1	6.9	7.2	6.7	2.7	0	6.9
Out of Business (per cent)	5.9	9.5	9.2	11.8	9.3	8	14.3	10
Mean equity total raised £m (i.e. total funding package)	5.4	0.52	4.47	0.43	0.28	3.28	1.48	4.17
Median equity total raised (£m)	2.58	0.68	0.8	0.51	0.34	0.42	1.37	0.7
Mean no. of follow-on funding rounds	1.5	1.5	1.4	0.5	0.8	2	1	1.3

Appendix 2: Methodology

The control sample was matched to the treated firms by sector (measured by 1 and 4 digit Standard Industrial Classification codes) and by the date of incorporation (which matched age and employment levels). Approximately ten firms were taken as the control sample for each firm in the treated sample.⁹⁴ The numbers are not exact as small modifications were made to ensure representative regional coverage. The 10:1 control-to-treatment sample ratio was chosen to ensure a sufficiently large number of firms could be analysed to make the results statistically meaningful (i.e. approximately 400 observations or higher). The number of observations is lower than the total sample size because of the problems of missing data that plague economic analysis of small firms.

The treated firms and controls together generated a rich dataset of 7,741 companies tracked over a maximum of 13 years (1995 to 2008). The data starts before the first scheme was introduced in order to pick up the behaviour of firms before they received investment. Due to the higher prevalence of firms being born at, or around, the point of their first supported external equity investment, the majority of the data is concentrated between the years 2003–2008. The average age of firms is 4.1 years, the mean total investment is £4.1 million, which reflects a strong skew as the median total investment is £0.7 million.

The data from the six schemes are aggregated in order to conduct the analysis across a sufficient number of cases. While separate programmes, their similarities in terms of stage of investment financed, fund structures used and sought outcomes are sufficiently common to allow such an aggregation.⁹⁵

Our estimation techniques involve two different types of econometric model, each of which makes explicit and different assumptions about the world. The first are ‘Fixed Effect (FE) models’ where variables are assumed to be constant across years and vary only between companies. This provides estimates of firm-specific differences and allows ‘before and after’ analysis of the impact of funding on firms. These methods control for any biases that might emerge if (higher quality) firms self-select, or are selected, into the funding schemes.

The second type is ‘Random Effects (RE) models’, where variables are assumed to vary from year to year within companies. These models are used across the treated and untreated samples to explore more subtle changes through time. The empirical findings are robust across both types of model specifications. The same, or very similar, models and methods were used in this analysis as were used in the Cowling *et al.*⁹⁶ analysis of the VCT and EIS schemes. This allows us to compare results across the different schemes using consistent methods. Full details of how the models were developed and their sensitivity analysis can be found in Cowling *et al.*⁹⁷

It is pertinent to outline some caveats that must be borne in mind when considering our results and any sources of potential bias in the findings.

Due to the nature of the datasets used, the impact of other publicly supported schemes such as the Enterprise Investment Scheme (EIS) or Venture Capital Trusts (VCTs) which respondent companies may also have accessed at the same time as they accessed the hybrid schemes cannot be examined. We are however

94. The numbers are not exact as small modifications were made to ensure representative regional coverage.

95. Essentially, all the schemes seek to enable a significant increase in economic activity among the invested firms which will thereby allow the hybrid funds to achieve positive internal rates of return (and capital multiples) that will satisfy the risk adjusted investment expectations of the participating institutional, (i.e. commercial) investors participating in the schemes. From the public perspective, a net return on the government funds invested equivalent to the exchequer's cost of capital once the benefits to the recipients portfolio firms have been realised is the totality of public rewards sought from the programmes.

96. This former finding would support Lockett and Wright (2005) who find frequent limitations in the managerial capabilities of European technology transfer offices.

97. *Ibid.*

able to analyse them in isolation using methods that allow a direct comparison across the schemes.

Again, due to the datasets used, many potentially important company characteristics are not available for inclusion in our analysis. For example, we have only limited data on the managerial experience and quality of the entrepreneurs and management teams involved in the firms in our sample.

The company accounts data also have substantial variability in terms of missing data. Databases of small and medium sized enterprise accounting and financial data are particularly vulnerable to missing or inaccurate information. This means that generalising our results to a broader SME population should be done cautiously. Sensitivity analysis of the dataset used in the VCT-EIS evaluation suggested that missing data in the FAME dataset does not introduce systemic bias.

It is difficult to predict how these factors might bias the results or the likely direction of such bias. However, the study has some important advantages that support our overall confidence in the results.

First, the dataset is unique and uses recorded performance data which is often superior to survey-based, subjectively reported measures. It permits the examination of the absolute and relative effects of scheme funding across a reasonable number of observations through time.

Second, our use of advanced panel data estimation techniques allows us to be more confident that our statistical estimates accurately represent the underlying relationships examined while addressing and controlling for unobservable company effects. Because the coefficients produced by the random effects and fixed effects models are very similar we can be confident that we have control for firm specific effects.

All the same, the results need to be interpreted carefully. Differences in performance between firms can take several years to become apparent even using large datasets and sophisticated econometric methods. As a result, the analysis is more informative about policies the further back in time we look. Ideally investment policies require a decade or more of data before they can be authoritatively evaluated. (It is acknowledged that this is an unrealistic scenario given the pressures of

accountability on government.) This means, unfortunately, that there is a trade-off in any evaluation between what can be said about the long-term impact of an extant policy and the current relevance of information about older and sometimes terminated schemes. Thus, the results of the analysis of more recently introduced schemes are likely to present a more negative picture of performance than might be expected when they have completed the investment cycle.⁹⁸ We know that in VC funding, the 'J Curve' effect means that negative performance results occur before the returns from realised investments improve fund performance.⁹⁹

Different interpretations of the behaviour of the hybrid VC funding system will reveal themselves in the data in different ways. If the original New Economy rhetoric is true and the UK only suffers from a supply side problem in the provision of funding, we would expect the schemes to have a major impact on the performance of the firms that are funded. For example, we would expect to see substantially higher growth, employment or sales. This would not necessarily happen immediately, as firms would need time to invest their new resources, but we would expect to see major differences in performance. A more subtle view of the impact of funding would be that most firms that receive funding are likely to be poor performers, but some firms that have high potential will be unleashed by additional funding and we should see a small number of exceptionally high performing firms. However, if there is only a demand side problem, and the UK suffers from a lack of investment-worthy firms, we would not expect to see much impact. A more complicated picture is an indication of more complicated problems.

98. This is because human capital in the sector is likely to have improved, the average size of many of the funds has increased and parts of the UK economy (such as the University system) is now more VC-friendly than it was in the late 1990s.

99. Burgel, O. (2000) UK. Venture Capital and Private Equity as an Asset Class for Institutional Investors, London, London Business School/BVCA.



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