THE ENTREPRENEURIAL STATE

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DEMOS

Introduction and summary

Across the globe we are hearing that the state has to be cut back in order to foster a post-crisis recovery, unleashing the power of entrepreneurship and innovation in the private sector. This feeds a perceived contrast that is repeatedly drawn by the media, business and libertarian politicians of a dynamic, innovative, competitive private sector versus a sluggish, bureaucratic, inertial, 'meddling' public sector. So much so that it is virtually accepted by the public as a 'common sense' truth.

For example, in his budget speech of June 2010, a month after taking office, the Chancellor, George Osborne, stated that the public sector was 'crowding out' the private sector, providing an additional justification beyond the need to reduce the deficit, for a relative contraction of the state. Both in the documentation that supported that emergency budget, and subsequently, the Coalition Government has repeatedly called for a more 'balanced' economy, with private activity taking up a greater share of the total than has previously been the case. The Prime Minister, David Cameron, adopted a more polemic tone in a speech given to the Cardiff Spring Forum in March 2011 when he promised to take on the 'enemies of enterprise' working in government, which he defined as the 'bureaucrats in government departments'.[2] This is a rhetoric that fits with the Government's broader theme of the Big Society, where responsibility for the delivery of public services is shifted away from the state to individuals operating either on their own or by coming together through the third sector.

And it is not a view that is unique to the UK Government. *The Economist,* which often refers to government as a Hobbesian Leviathan,[3] recently argued that government should take the back seat and focus on creating freer markets and creating

the right conditions for new ideas to prosper, rather than taking a more activist approach.[4] The established business lobby groups have long argued for freedom from the long arm of the state, which they see as stifling their ability to succeed through the imposition of employee rights, tax and regulation. The right-wing Adam Smith Institute argues that the number of regulators in the UK should be reduced to enable the British economy to 'experience a burst of innovation and growth'.[5] In the USA, supporters of the Tea Party movement are united by a desire to limit state budgets and promote free markets.

While business as a whole may not see the virtues of anything that does not have a clear and positive impact on its bottom line, and nor arguably should it, there is a danger when a general desire to reduce the size of the state translates into weak and non-ambitious economic policy. When that happens, we are all losers: policy is not as effective as it could be and the potential to create greater prosperity is not fulfilled.

This pamphlet argues that there is a real danger of that happening in the field of innovation policy, greatly limiting its impact on economic growth. The view of the current government—shared by its predecessor—is that the role of the state in spurring innovation is simply to provide the 'conditions for innovation to flourish'.[6] The UK Government states that if it invests in skills and a strong science base, ensures a strong legal framework within an amenable macroeconomy, and supports entrepreneurial clusters, then the market will do the rest through the incentive of the profit motive.

The evidence presented in this pamphlet challenges this minimalist view of the state in the field of economic policy, arguing that a far more proactive role is required. The case that is made in these pages is that the role of the government, in the most successful economies, has gone way beyond creating the right infrastructure and setting the rules. It is a leading agent in achieving the type of innovative breakthroughs that allow companies, and economies, to grow, not just by creating the 'conditions' that enable innovation. Rather the state can proactively create strategy around a new

high growth area before the potential is understood by the business community (from the internet to nanotechnology), funding the most uncertain phase of the research that the private sector is too risk-averse to engage with, seeking and commissioning further developments, and often even overseeing the commercialisation process.. In this sense it has played an important entrepreneurial role.

Of course there are plenty of examples of private sector entrepreneurial activity, from the role of young new companies in providing the dynamism behind new sectors (eg Google), to the important source of funding from private sources like venture capital. But this is the only story that is usually told. Silicon Valley and the emergence of the biotech industry are usually attributed to the geniuses behind the small high tech firms like Facebook or the plethora of small biotech companies in Boston or Cambridge in the UK. Europe's 'lag' behind the USA is often attributed to its weak venture capital sector. Examples from these high tech sectors in the USA are often used to argue why we need less state and more market: to allow Europe to produce its own Googles. But how many people know that the algorithm that led to Google's success was funded by a public sector National Science Foundation grant?[7] Or that molecular antibodies, which provided the foundation for biotechnology before venture capital moved into the sector, were discovered in public Medical Research Council (MRC) labs in the UK? Or that many of the most innovative young companies in the USA were funded not by private venture capital but by public venture capital such as through the Small Business Innovation Research (SBIR) programme?

Lessons from these experiences are important. They force the debate to go beyond the role of the state in stimulating demand, or the role of the state in 'picking winners' in industrial policy, where taxpayers' money is potentially misdirected to badly managed firms in the name of progress, distorting incentives as it goes along. Instead it is a case for a targeted, proactive, *entrepreneurial* state, able to take risks, creating a highly networked system of actors harnessing the

best of the private sector for the national good over a medium- to long-term horizon. It is the state as catalyst, and lead investor, sparking the initial reaction in a network that will then cause knowledge to spread. The state as creator of the knowledge economy.

It cannot be called 'new' industrial policy because it is in fact what has happened, though in a 'hidden way' to prevent a backlash, over the last three decades in the development of the computer industry, the internet, the pharma–biotech industry, and many more including today's nanotech industry.[8] None of these technological revolutions would have occurred without the *leading* role of the state. It is about admitting that in many cases, it has in fact been the state, not the private sector, that has had the vision for strategic change, daring to think—against all odds—about the 'impossible', creating a new technological opportunity, making the large necessary investments, and enabling a decentralised network of actors to enable the risky research, and to allow the development and commercialisation process to occur in a dynamic way.

This pamphlet draws together recent academic literature to make new policy conclusions. In doing so it presents a very timely contribution to the debate around deficit reduction in the UK and elsewhere. And in passing, it confronts head-on some issues that have come to be taken for granted by mainstream policy makers, such as the usefulness of data on patenting and R&D expenditure as proxies for wealth-creating innovation. The part played by the small firm in creating growth is also put under scrutiny as is the role of venture capital.

This is not a pamphlet about innovation policy. Many themes on that general topic are missing here: the skills gap, diffusion of existing innovations, procurement and deployment. It is about the entrepreneurial role that the state has played in different innovation contexts, leading rather than following. Thinking out of the box, defining new radical technologies and the associated eras (the knowledge economy), rather than just reacting to them. Understanding this lesson forces us to rethink what the state brings to

the ecology of the business-government partnerships so discussed today.

The main task is to unpack the role of the state in fostering radical growth-enhancing innovations, and so to make recommendations that would not only improve the effectiveness of economic policy but also ensure that the limited taxpayers' money that is available is more effectively spent. The fear is that without understanding the proactive role required of government for an effective economic policy, the UK economy will fail to achieve its potential at precisely the time when economic dynamism is most necessary.

The report is structured as follows. Chapter 1 sets the scene by summarising the academic framework regarding the debate around growth; whereas a generation ago, technological advance was seen as something that was externally given, there is now extensive literature to show that actually it is the rate, and direction, of innovation that drives the ability for economies to grow. This provides the justification for increased focus on the role that government can play to facilitate precisely that innovation, while at the same time exploding some of the myths that abound in Westminster, the European Commission and Washington about what actually drives innovation and growth. Specifically, it draws on recent academic literature to show that targeting resources towards R&D spend, patenting or small firms in isolation misses the point and that similarly waiting for venture capital to do all the heavy lifting is likely to be futile.

Chapter 2 describes the importance of the government's role in investing where the private sector will not, in the most uncertain risky areas. But rather than understanding this through the usual lens of 'market failures', the concept of entrepreneurial risk-taking is introduced. The public sector has indeed fulfilled an important role in undertaking the most risky research, even when that research was not 'basic'. Private sector examples are provided from the pharmaceutical and biotech industries where it has been the state, not the private sector, that has created economic dynamism. Risky research

is funded by the publicly funded labs (the National Institutes of Health or the MRC) while private pharma focuses on less innovative 'me too drugs' and private venture capitalists enter only once the real risk has been absorbed by the state. And yet make all the money. In industries with such long time horizons and complex technologies, it is argued that return-hungry venture capital can in fact sometimes be more damaging than helpful to the ability of the sector to produce valuable new products.

Chapter 3 argues that it is only by creating a so-called national system of innovation built on sharing knowledge that the necessary, if not sufficient, conditions start to be established. An example is drawn by comparing and contrasting the two examples of Japan and the Soviet Union. It then develops the concept of the entrepreneurial state where not only is there a fully functioning national system of innovation, but this system is catalysed by proactive, flexible, decentralised action on the part of government.

Chapter 4 examines aspects of the recent industrial policy history of the USA, and shows that despite common perceptions, the US state has been extremely proactive and entrepreneurial in the development and commercialisation of new technologies. Four examples—the Defense Advanced Research Projects Agency (DARPA), Small Business Innovation Research (SBIR), orphan drugs and recent developments in nanotechnology—are used to illustrate this point.

Chapter 5 provides some reflections that are relevant to the situation faced by the UK at the moment, with policy recommendations for the development of green technology, and technology, generally. Green technology has the potential to become the next technological revolution, but as no other technological revolution has simply been 'nudged' by the state, it is unrealistic that this one can be without the type of large scale (though decentralised) investments that have been made in the case of other important new technologies.

And finally, chapter 6 concludes with some reflections on the implications of the concept of the entrepreneurial state for the debate around fairness and distribution.

Taken together, the pamphlet paints a fuller understanding of the public sector's centrality to risk-taking and radical growth fostering technological change. It builds a very different picture of the state from that envisaged by present economic policy, which denies it any leading role in innovation and production, and that of conventional industrial policy, which unduly downplays its scope for pioneering and promoting new technologies. In contrast, it describes scenarios where the state has provided the main source of dynamism and innovation in advanced industrial economies, pointing out that the public sector has been the lead player in what is often referred to as the 'knowledge economy'—an economy driven by technological change and knowledge production and diffusion. Indeed, from the development of aviation, nuclear energy, computers, the internet, the biotechnology revolution, nanotechnology and even now in green technology, it is, and has been, the state not the private sector that has kick-started and developed the engine of growth, because of its willingness to take risk in areas where the private sector has been too risk-averse. In a policy environment where the frontiers of the state are now being deliberately rolled back, that process needs more than ever to be understood so that it can successfully be replicated. Otherwise we miss an opportunity to build greater prosperity in the future.

Recommendations

This is a summary of the main recommendations:

- Reduce government spending on direct transfers to small firms, such as small business rates relief and inheritance tax relief. This is a cost saving.
- If the Small Business Research Initiative (SBRI) is enhanced, as the government has indicated, it must be done in a way that focuses on how to get SMEs to spend money on new technologies. To do so, it will need to increase the size of the project financing that it administers (too diluted currently), and concentrate on firms that prove they will spend on innovation. This is cost neutral.
- Abandon initiatives to establish a UK patent box (a preferential tax regime for profits arising from patents), which would not increase innovation and according to the Institute for Fiscal Studies would in time lead to greater taxpayer costs. This is a cost saving.
- Review R&D tax credits with a view to ensuring that firms are held accountable for actually spending the money on innovation, and failing that, shift away from blanket R&D tax credits to free up resources towards direct commissioning of the technological advance in question. This is a potential cost saving.
- Enterprise zones, that give regulatory or taxation advantages to firms in a certain area, are a distraction as they do not cause innovation to happen that would not have taken place elsewhere. Best to use the money in other ways. This is a cost saving.
- When successful, a part of the return from investments made with significant public support should be returned to government. This is a potential cost saving.

- Use these freed-up resources to engage in a massive expansion of the Technology Strategy Board, structured in line with the model of the US DARPA to directly enable innovation (research, development and commercialisation) through a bottom-up government-directed network of agencies, in line with recommendations of the Confederation of British Industry (CBI) in 2006.[9] It also requires more transparency about funding decisions and clearer auditing of performance so that failing performance areas are cut off. This would increase expenditure.
- Adopt a more proactive interventionist approach to green technology innovation, drawing on the UK's specific strengths. This would increase expenditure.
- The time any private equity investment must be held before the gains from sale can be exempt from capital gains tax, should be raised in the UK to at least five years (currently only two, previously ten in 2002). This would help prevent the 'take the money and run' in green tech, which has characterised investments in biotechnology companies, most of which remain 'product-less'. This is a cost saving.
- Short-termism is especially problematic in contexts in which radical technological change is needed and the reason why venture capital and other forms of private equity are not playing a leading role in green technology. Given the lack of private investments, the UK government should step up and increase its 'green' budget. The Green Investment Bank is not enough. This would increase expenditure.

1 From invisible hand to modern myths

The view of the current UK Government regarding its role in stimulating innovation is to create an environment where the private sector can flourish. A growth review by the Department for Business, Innovation and Skills (BIS) and HM Treasury said it is to 'provide the conditions for private sector growth and investment'.[10]

The core of the BIS and Treasury plan outlines the way that government must be limited, reducing red tape and bureaucracy so the private sector can get on with what it does best: investing, innovating, employing:

A new approach to growth requires a new attitude in Government. Government on its own cannot create growth. It is the decisions of business leaders, entrepreneurs and individual workers which build our economy. What the Government can do is provide the conditions for success to promote a new economic dynamism — harnessing our economic strengths, removing the barriers which prevent markets from supporting enterprise, and putting the private sector first when making decisions on tax, regulation and spending.[11]

In a special report on the world economy *The Economist* stated:

A smart innovation agenda, in short, would be quite different from the one that most rich governments seem to favour. It would be more about freeing markets and less about picking winners; more about creating the right conditions for bright ideas to emerge and less about promises like green jobs. But pursuing that kind of policy requires courage and vision — and most of the rich economies are not displaying enough of either.[12]

This view is also espoused by some 'progressive' academics, who argue that the state is limited to:

Creation of the conditions for innovation… accepting that the state will have a vital role in ensuring that market conditions reach the 'just right' balance which will spur innovation and that adequate investment is available for innovators.[13]

This is the view that justifies little more of government than correcting market failures—through investment in basic science, education and infrastructure, for example. This is not a new debate, but it is one that benefits from a greater understanding of the academic literature on the role of innovation in creating economic growth.

More than 250 years ago, when discussing his notion of the 'Invisible Hand' Adam Smith argued that capitalist markets left on their own would self-regulate, with the state's role being limited to that of creating basic infrastructure (schools, hospitals, motorways) and making sure that private property, and other institutions such as 'trust', were nurtured and protected.[14] His background in politics and philosophy meant that his writings were much more profound than the simple libertarian economics position for which he is usually acknowledged, but there is no escaping that he believed that the magic of capitalism consisted in the ability of the market to organise production and distribution without coercion by the state. Karl Polanyi, the acclaimed sociologist of capitalism, has instead shown how the notion of the market as self-regulating is a myth from the historical beginning of markets: 'The road to the free market was opened and kept open by an enormous increase in continuous, centrally organized and controlled interventionism.'[15] In this view, it was the state which imposed the emergence of the market.

John Maynard Keynes believed that capitalist markets, regardless of their origin, need constant regulation because of the inherent instability of capitalism where private business investment (one of the four categories of spending in GDP) is extremely volatile. The reason it is so volatile is that far from

being a simple function of interest rates or taxes,[16] it is subject to 'animal spirits'—the gut instinct of investors about future growth prospects in an economy or specific sector.[17] In his view this uncertainty creates constant periods of underinvestment, or overinvestment, causing severe economic fluctuations due to the multiplier effect (whereby an increase or fall in spending is propagated throughout the economy by subsequent rounds of the fall or increase). Unless regulated by increased government spending, falls in spending can lead to the emergence of depressions, a fact of life before Keynes' ideas found their way into post-Second World War economic policies.

More recently, Hyman Minsky focused on the *financial* fragility of capitalism, the way that financial markets cause periodic crises to occur due to cycles of expansion, exaggerated expectations and credit formation, followed by retraction, causing bubbles to burst and asset prices to collapse. He too believed that the state had a crucial role in preventing this vicious cycle from happening, and for growth to follow a more stable path.[18]

Keynes and Minsky focused on the need for the state to intervene in order to bring stability and prevent crises, certainly a pressing issue in today's circumstances. The pamphlet focuses on the role of the state in allowing private and public organisations to interact in such a way that new knowledge is produced and diffused throughout the economy to allow structural change and growth. But to understand the dynamics of such investments it is fundamental first to better understand different perspectives on the theory of economic growth, and the role of technology and innovation in this process.

Where does growth come from?

While growth and the wealth of nations has been the lead concern of economists since Adam Smith, in the 1950s it was shown by Moses Abramovitz and Robert Solow that conventional measures of capital and labour inputs could not account for 90 per cent of economic growth in an advanced industrialised country such as the United States.[19]

It was assumed that the unexplained residual must reflect productivity growth, rather than the quantity of factors of production. And still today there is immense debate among economists over which factors are most important in producing growth. This debate is reflected in politics where different views about growth are espoused with great vehemence, often ignorant of the underlying theoretical assumptions and origins, so well put by Keynes:

The ideas of economists and political philosophers, both when they are right and when they are wrong, are more powerful than is commonly understood. Indeed the world is ruled by little else. Practical men, who believe themselves to be quite exempt from any intellectual influence, are usually the slaves of some defunct economist. Madmen in authority, who hear voices in the air, are distilling their frenzy from some academic scribbler of a few years back. I am sure that the power of vested interests is vastly exaggerated compared with the gradual encroachment of ideas.[20]

For years, economists have tried to model growth. Neoclassical economics developed its first growth model in the work of Harrod and Domar, but it was Robert Solow who won the Nobel Prize for his growth 'theory'. In the Solow growth model, growth is modelled through a production function where output (Y) is a function of the quantity of physical capital (K) and human labour (L), ceteris paribus—other things remaining equal. What other things? Technological change.

$$Y = F(K, L)$$

Changes in these two inputs cause changes along the function whereas upward or downward shifts in the function would be caused by technological change. When Solow discovered that 90 per cent of variation in output was not explained by capital and labour, he called the residual 'technical change'.[21]

What perhaps should have happened at this point is that if the underlying model is found to be so deficient that it cannot explain 90 per cent of the dependent variable that it is meant to explain, a new model should have been developed. This was indeed what many, such as Joan Robinson, had been arguing for decades, highly critical of the production function framework.[22] Instead technical change was added in. Solow's theory became known as 'exogenous growth theory' because the variable for technology was inserted exogenously, as a time trend A (t) (similar to population growth):

$$Y = A(t)\, F(K, L)$$

As economists became more and more aware of the crucial role that technology plays in economic growth, it became necessary to think more seriously about how to include technology in growth models. This gave rise to 'endogenous' or 'new growth' theory, which modelled technology as the endogenous outcome of an R&D investment function, and as investment in human capital formation.[23] Rather than assuming constant or diminishing marginal returns as in the Solow model (every extra unit of capital employed earned a smaller return), the addition of human capital and technology introduced *increasing returns to scale,* the engine of growth. Increasing returns, which arise from different types of dynamic behaviour like learning by doing, can help explain why certain firms or countries persistently outperform others—there is no 'catch-up' effect.

Although new growth theory provided a rational argument for government investment it did not lead to it explicitly. This is because in this framework it was ideas that were endogenous not the institutional framework required to transform ideas into products. Nevertheless, the increasing emphasis on the relationship between technical change and growth indirectly led government policies to focus on the importance of investments in technology and human capital to foster growth, leading to *innovation-led growth* policies in the knowledge economy, a term used to denote the greater

importance in the competition process of investing in knowledge creation.[24] Studies that showed a direct relationship between the market value of firms and their innovation performance measured by R&D spending and patents supported these policies.[25]

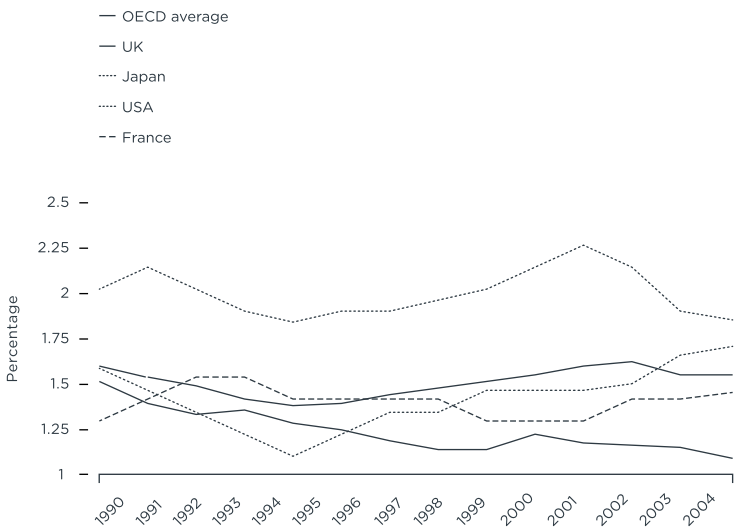
At the same time, there was an emerging field called Evolutionary Economics. In their ground-breaking *An Evolutionary Theory of Economic Change,* Nelson and Winter argued that in fact the production function framework (exogenous or endogenous) was the wrong one to use to understand technological change. It argued for an 'evolutionary theory' of production (and economic change), which delved inside the 'black box' of the production function to understand how innovation takes place and its effect on growth.[26] In this approach, there is no 'representative agent' but rather a constant process of differentiation among firms, based on their different abilities to innovate because of different internal routines and competencies. Competition in this perspective is about the co-evolution of those processes that create constant differences between firms and the processes of competitive selection that winnow in on those differences, allowing only some firms to survive and grow. In this context, since innovation is firm-specific, and highly uncertain, the types of policies that emerge for supporting innovation are different from those that emerge from a theoretical apparatus that assumes away the heterogeneity and uncertainty, as will be discussed in chapter 3, when we consider national systems of innovation.

R&D targets

The fact that economics was putting so much emphasis on innovation in the growth process caused policy makers, since the 1980s, to begin paying much more attention to variables like research and development (R&D) and patents, as a predicator of innovation and therefore of economic growth.[27] For example, the European Union's Lisbon Agenda (2000) and its current Europe 2020 strategy[28] set a target for 3 per cent of

the EU's GDP to be invested in R&D, along with policies that try to encourage the flow of knowledge between universities and business, the creation of credit and venture capital for SMEs, and other factors identified as important for innovation-led growth.[29] UK policy has also put a lot of emphasis on R&D,[30] but as can be seen in figure 1, from 1990 to 2003 the UK ranked below average compared with other major European competitors in its business R&D (BERD) spending.

Figure 1 **Business R&D (BERD) as a percentage of GDP**



Source: OECD Main Science and Technology Indicators 200531

This is not necessarily a problem as the sectors that the UK specialises in—financial services, construction and creative industries (such as music)—are not sectors in which innovation occurs necessarily through R&D.[32] There are many industries, especially in the service sector, that do no R&D. Yet these industries often employ large numbers of knowledge workers

to generate, absorb and analyse information. If, all other things equal, these industries represented a smaller proportion of GDP, it would be easier for an economy to reach the 3 per cent target. But would the performance of the economy be superior as a result? It depends on how these industries contribute to the economy. Are these 'low-tech' industries providing important services that enhance the value-creating capabilities of other industries or the welfare of households as consumers? Or are they, as is often the case in financial services, focused on extracting value form the economy, even if that process undermines the conditions for innovation in other industries?[33]

One of the problems that such simple targets encounter is that they divert attention from the vast differences in R&D spending across industries and even across firms within an industry. They can also mask significant differences in the complementary levels of R&D investments by governments and businesses that are required to generate superior economic performance. An even greater problem with R&D-based innovation policies is the lack of understanding of the complementary assets that must be in place to allow technological innovations to reach the market, eg infrastructure or capabilities around marketing.

Myth-busting 1: R&D is not enough

The literature on the economics of innovation, from different camps, has often assumed a direct causal link between R&D and innovation, and between innovation and economic growth. Yet, surprisingly, there are very few studies which prove that innovation carried out by large or small firms actually increases their growth performance — the macro models on innovation and growth do not seem to have strong empirical 'micro foundations'.[34] Some company level studies have found a positive impact of innovation on growth35 while others no significant impact.[36] And some studies have found even a negative impact of R&D on growth, which is not surprising: if the firms in the sample don't have the complementary

characteristics needed, R&D becomes only a cost.[37]

It is thus fundamental to identify the company specific conditions that must be present to allow spending on innovation to affect growth. These conditions will no doubt differ between sectors. Demirel and Mazzucato, for example, find that in the pharmaceutical industry, only those firms that patent five years in a row (the 'persistent' patenters) and which engage in alliances achieve any growth from their R&D spending.[38] Innovation policies in this sector must thus target not only R&D but also attributes of firms. Coad and Rao found that only the fastest growing firms reap benefits from their R&D spending (the top 6 per cent identified in Nesta's report 'The vital 6 per cent').[39] And Mazzucato and Parris find that this result, of the importance of high growth firms, only holds in specific periods of the industry life-cycle when competition is particularly fierce.[40]

Myth-busting 2: Small is not necessarily beautiful

This finding that the impact of innovation on growth is indeed different for different types of firms has important implications for the commonly held assumption that 'small firms' matter (for growth, for innovation), and hence for the many different policies that target SMEs. The hype around small firms arises mainly from the confusion between size and growth. The most robust evidence is not on the role of small firms in the economy but the role of *young* high growth firms. Nesta, for example, claims that the most important firms for UK growth have been the small number of fast growing businesses that between 2002 and 2008 generated the highest amount of employment growth in the UK.[41] And while many high growth firms are small, many small firms are not high growth. The bursts of fast growth that promote innovation and create employment are often staged by firms that have existed for several years and grown incrementally until they reach a take-off stage. This is a major problem since so many government policies aim to target tax breaks and benefits to SMEs, with the aim of making the economy more innovative and productive.

Although there is much talk about small firms creating jobs,[42] this is just a myth because while by definition small firms will cause jobs to increase, in fact many small firms also destroy a large number of jobs when they go out of business. Haltiwanger, Jarmin and Miranda find that there is indeed no systematic relationship between firm size and growth.[43] Most of the effect is from age: young firms (and business start-ups) contribute substantially to both gross and net job creation.

Productivity should be the focus, and small firms are indeed often less productive than large firms. Recent evidence has suggested that some economies that have favoured small firms, such as India, have in fact been punished. Hsieh and Klenow, for example, suggest that 40–60 per cent of the total factor productivity (TFP) difference between India and the USA is due to misallocation of output to too many small and low productivity SMEs in India.[44] As most small start-up firms fail, or are incapable of growing beyond the sole owner-operator, targeting assistance to them through grants, soft loans or tax breaks will necessarily involve a high degree of waste.

Bloom and Van Reenan argue that small firms are less productive than large ones because they are less well managed, and subject to provincial family favouritism.[45] Furthermore, small firms have lower average wages, fewer skilled workers, less training, fewer fringe benefits and are more likely to go bankrupt. They argue that the UK has many family firms and a poor record of management in comparison with other countries such as the USA and Germany.[46] Among other reasons, this is related to the fact that the tax system is distorted to give inheritance tax breaks to family firms.

Some have interpreted the result that it is high growth rather than size that matters to mean that the best that governments can do is to provide the conditions for growth innovation. Bloom and Van Reenan argue that instead of having tax breaks and benefits target SMEs, the best way to support small firms is to 'ensure a level playing field by removing entry barriers to firms of all sizes, reducing barriers to growth, enforcing competition policy and strongly resisting the lobbying efforts of larger firms and their agents'.[47] But as

we will see in chapters 3 and 5, often the most innovative firms are precisely those that have benefitted the most from direct public investments of different types, making the case much more complex.

Myth-busting 3: Venture capital is not so risk-loving

If the role of small firms and R&D is overstated by policy makers, a similar hype exists in relation to the potential for venture capital to create growth, particularly in knowledge-based sectors where capital intensity and technological complexity are high.

Venture capital is a type of private equity capital focused on early-stage, high-potential, growth companies. The funding tends to come either as seed funding or as later growth funding where the objective is to earn a high return after the IPO of the company or sale. Venture capital fills a void of funding for new firms, which often have trouble gaining credit from traditional financial institutions such as banks and thus often have to rely on other sorts of funding such as 'business angels' (including family and friends), venture capital and private equity. Such alternative funding is most important for new knowledge-based firms trying to enter existing sectors or new firms trying to form a new sector.

Risk capital is so scarce in the seed stage because there is a much higher degree of risk in this early phase, when the technological and demand conditions are completely uncertain. The falling risk in the different phases falls dramatically with the seed financing occurring when there is the most uncertainty about the potential of the new idea (table 1).

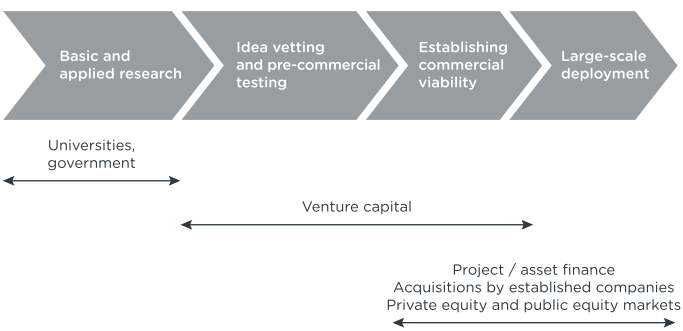
Table 1 **Risk of loss for different stages at which investments are made (%)**

Point at which investment made	Risk of loss
Seed stage	66.2%
Start-up stage	53.0%
Second stage	33.7%
Third stage	20.1%
Bridge or pre-public stage	20.9%

Source: Pierrakis [48]

Figure 2 shows the usual place that it is assumed that venture capital will enter the stage of the invention-innovation process. In reality the real picture is much more non-linear and full of feedback loops. And many firms die during the transition between a new scientific or engineering discovery and its successful commercial transformation and application. Thus the third phase shown in figure 2 of commercial viability is often referred to as the valley of death.

Figure 2 **Stages of venture capital investment**



Source: Ghosh and Nanda [49]

Figure 2 does not illustrate how time after time it has been public rather than privately funded venture capital that has taken the most risks. In the USA, government programmes such as the Small Business Innovation Research (SBIR) programme and the Advanced Technology Program (ATP) in the US Dept of Commerce have provided 20–25 per cent of total funding for early stage technology firms. Thus government has played a leading role not only in the early stage research illustrated in figure 2, but also in the commercial viability stage. Auerswald and Branscomb claim that government funding for early stage technology firms is equal to the total investments of 'business angels' and about two to eight times the amount invested by private venture capital.[50]

Venture capital funds tend to be concentrated in areas of high potential growth, low technological complexity and low capital investment since the latter raises the cost significantly. Since there are so many failures in the high risk area, venture capital funds tend to have a portfolio of different investments with only the tails earning high returns—a very skewed distribution.

Although most venture capital funds are usually structured to have a life of ten years, because of the management fees and the bonuses earned for high returns, venture capital funds tend to prefer to exit much earlier than ten years, in order to establish a track record and raise a follow-on fund. This creates a situation whereby venture capital funds therefore have a bias towards investing in projects where the commercial viability is established within a three to five year period.[51] Although this is sometimes possible (eg Google) it is often not. And surely, in the case of an emerging sector like biotech or green tech today, where the underlying knowledge base is still in its early exploratory phase, such a short term bias is damaging to the scientific exploration process, which requires longer time horizons and more willingness to risk failure.

The role of US venture capital that worked was to provide not only committed finance, but also managerial expertise and ensure the building of a viable organisation.[52]

The problem has been not only the lack of venture capital investment in the most needed early seed stage, but also its objectives in the process. This has been strongly evidenced in the biotech industry where an increasing number of researchers have criticised the model of venture capital in science, indicating that significant investor speculation has a detrimental effect on the underlying innovation.[53] The fact that so many venture-capital-backed biotech companies end up producing nothing, yet make millions for the venture capital firms that sell them on the public market, is highly problematic for the role of venture capital in the development of science and its effect on the growth process. The increased presence of patenting and venture capital is not the right one for allowing risky and long term innovations to come about. Pisano in fact claimed that the stock market was never designed to deal with the governance challenges of R&D entities.[54] Mirowski describes the venture-capital–biotech model as:

commercialized scientific research in the absence of any product lines, heavily dependent upon early-stage venture capital and a later IPO launch, deriving from or displacing academic research, with mergers and acquisitions as the most common terminal state, pitched to facilitate the outsourcing of R&D from large corporations bent upon shedding their previous in-house capacity.[55]

The problem with the model has been that the 'progressive commercialisation of science' seems to be unproductive, with few products, and damage to long-run scientific discoveries and findings over time.

Myth-busting 4: A patent doesn't necessarily mean progress

A similar misunderstanding exists in relation to the role of patents in innovation and economic growth. For example, when policy makers look at the number of patents in the pharmaceutical industry, they presume it is one of the most

innovative private sectors in the world. This rise in patents does not however reflect a rise in innovation, but a change in patent laws and a rise in the strategic reasons why patents are being used. This has caused their importance to be greatly hyped up—mythologised.

The exponential rise in patents, and the increasing lack of relationship this rise has had with actual 'innovation' (eg new products and processes), has occurred for various reasons. First, the types of inventions that can be patented has widened to include publicly funded research, upstream research tools (rather than only final products and processes) and even 'discoveries' (rather than only inventions) of existing matter such as genes. The 1980 Bayh-Dole Act, which allowed publicly funded research to be patented rather than remain in the public domain, encouraged the emergence of the biotechnology industry as most of the new biotech companies were new spin-offs from university labs with heavy state funding. Furthermore, the fact that venture capital often uses patents to signal which companies to invest in means that patents have increased in their strategic value to companies that need to attract financing. All these factors have caused the number of patents to rise, with most of them being of little worth (eg very few citations received from other patents) and without resulting in a high number of innovations, eg new drugs in pharma (figure 5). Thus directing too much attention to patents, rather than to specific types of patents, such as those that have high citations, risks wasting much money (as argued below for the patent box case).

Researchers have argued that many of the recent trends in patents, such as the increase in upstream patents (eg patenting of 'research tools'), has caused the rate of innovation to fall rather than increase as it blocks the ability of science to move forwards in an open exploratory way.[56] The effect has been especially deleterious to the ability of scientists in the developing world to repeat experiments carried out in the developed world, before undertaking their own developments on those experiments, thus hurting their ability to 'catch up'.[57]

Notwithstanding the fact that most patents are of little value, and the controversial role that patents play in innovation dynamics, the UK Government insists that patents have a strong link to ongoing high-tech R&D and must thus be incentivised in order for the UK to have innovation-led growth. Thus in October 2010 Osborne announced a patent box policy, due to begin in 2013, which would reduce the rate of corporation tax on the income derived from patents (to 10 per cent). This of course fits with the current government's belief that investment and innovation can be easily nudged via taxes.

The Institute for Fiscal Studies (IFS) has argued against this policy, claiming that the only effect it will have is to reduce government tax revenue (by a large amount) without affecting innovation. It is argued that R&D tax credits are enough to address the market failure issue around R&D, and that the patent box policy is instead poorly targeted at research, as the policy targets the income that results from patented technology, not the research itself (a similar claim we make around R&D tax credits when they are not subject to control). A recent report by the IFS claims:

Once a patent is in place, a firm has a monopoly on the use of those ideas, and so can capture all of the returns and therefore faces the correct incentives to maximise the related income stream. In addition, to the extent that a Patent Box reduces the tax rate for activity that would have occurred in the absence of government intervention, the policy includes a large deadweight cost.[58]

Furthermore, the authors claim that the patent box policy will also add complexity to the tax system and require expensive policing to ensure that income and costs are being appropriately assigned to patents. They claim that the great uncertainty and time lags behind creating patentable technologies will counteract the incentives, and since international collaborations are increasingly common, there is no guarantee that the extra research that is incentivised will be conducted in the UK.[59]

This chapter shows that many of the assumptions that underlie growth policy should not necessarily be taken for granted. Over the last decade or so, policy makers searching for proxies for economic growth have alighted on things they can measure such as R&D spend, patents, venture capital activity, and the number of small firms that are assumed to be important for growth. We have attempted to demystify these assumptions and now turn to the largest myth of all: the limited role for government in producing entrepreneurship, innovation and growth.