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**A manifesto for innovation and growth**  
A submission to the 2013 Spending Review

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The Big Innovation Centre is an initiative of The Work Foundation and Lancaster University. Launched in September 2011, it brings together a range of companies, trusts, universities and public bodies to research and propose practical reforms with the ambition of making the UK a global open innovation hub as part of the urgent task of rebalancing and growing the UK economy, and with the vision of building a world-class innovation and investment ecosystem by 2025. For further details, please visit [www.biginnovationcentre.com](http://www.biginnovationcentre.com).

## Headlines: A manifesto for innovation and growth

If the UK is to secure a lasting recovery then we have no option but to drive growth through innovation. The past 30 years have seen a fundamental shift in how our economy creates value and we are now reliant on innovation for growth. But in the run up to the credit crisis a number of structural issues built up in our economy. These are now holding us back.

Healthy businesses cannot access finance for growth. Firms with potential to drive forwards innovation are held back by weak leadership. Missing infrastructures make certain activities impossible. Weak national and local institutions make change difficult, and many organisations are struggling to exploit the opportunities presented by important, open, ways of driving innovation. These are not marginal issues which dampen growth or slow progress. They are fundamental blocks which prevent investment in the right areas and the development of the organisations with the greatest potential.

Targeted public spending is needed to overcome these structural problems in our economy and to ensure we can exploit the huge economic opportunities presented by new general purpose technologies:

- A targeted investment in capital projects and the underpinning infrastructures of innovation – in science, research and its technical application, in our digital infrastructure and to build local institutions capable of meeting business needs;
- Further efforts to address dysfunctional capital markets in order to increase both the demand for and supply of funds to innovative companies; and
- Funding a new form of industrial strategy. Developing the government's emerging approach to support innovation in areas of UK strength and to support the private sector in making new markets to exploit disruptive technologies.

The focus of the spending review must be on boosting the UK's innovation capacity. To date the Government have made a number of significant investments in innovation such as a £200m programme of Catapult Centres. But major spending decisions, such as spending billions on cutting corporation tax, reflect an out-of-date view of what drives growth.

This position is no longer tenable. The primary challenge today is the economy. Five years on from the start of the credit crisis we are still facing a contained depression. Economic growth has now been flat for three years, output is still well below 2008 levels, and even the more optimistic economic forecasts point to a weak and uncertain recovery over the next three years. Improving the functioning of the UK's innovation ecosystem has to be at the heart of both the current government and the next government's growth agenda.

## The UK's growth and innovation problem

The UK has an incredible set of assets which should underpin our ability to innovate. Academic rankings consistently cite UK universities as second only to those of the USA. We have incredible businesses which lead the world in areas as diverse as pharmaceuticals, finance and the creative industries. We have a world class business services infrastructure and the UK ranks as one of the easiest places in the world to do business.

Despite these assets, the UK economy is relatively weak in the fastest growing consumer markets. We run a trade deficit in many of these key markets – such as clothing and consumer electronics. Put simply, we do not seem to be very good at making the things that people increasingly want. It seems that large parts of our economy fail to support innovation. We do not appear to be able to connect together these strengths to develop new products and services which are truly valued.

It is possible to trace examples where we are missing out on potential new markets, despite initial UK advantages. For example in the disruptive technology graphene we now appear to be running to catch up with competitor nations, despite being the country which first developed this new wonder material.

Most damning of all, the evidence is that UK businesses are choosing not to invest in UK innovation. The run up to the recession was a time when corporate cash was increasing rapidly, but investment in innovation and intangible assets levelled off as a share of private sector gross value added. Now there are suggestions that the UK market is seen as a 'cash-cow' by global corporations, rather than a location for investment.

This apparent contradiction – incredible innovation assets, but poor outputs – is the result of a weak innovation system and structural failures within our economy:

- Our financial system supports property investment and failing firms, but lets down our innovators;
- Poor management skills are holding back innovative firms;
- The institutional support for innovation has become fragmented;
- In many places, local structures have become too chaotic to deliver what businesses need; and
- There are gaps in our capacity to exploit the opportunities presented by open ways of innovating.

The performance of our economy in the boom years was flattered by an asset bubble, cheap consumer credit and high public spending all fuelled by a trade deficit and a benign global economic environment. This is no longer the case and the credit crisis and ensuing recession has stripped our economy bare, and lasting growth is unlikely to return unless we can tackle these structural issues.

The challenge is that as a knowledge economy the UK has fundamentally changed to become reliant on innovation. This set of structural issues is holding back our ability to innovate and with it putting at risk our position as an affluent and prosperous knowledge economy. Rather than relying on mass production, physical assets, competition on cost or low wage labour, we create value from knowledge and expertise. How we work, the industries our economy leads in, what we export and how our businesses invest for the future have all changed. It is the growth of this knowledge intensive activity which has driven recovery from the past two recessions and has the potential to do so again now.

But the shift has also changed what drives economic advantage in our economy. Any advantage that a firm holds from a particular product or service line is increasingly temporary, as others can copy and imitate. But the power of a knowledge economy comes from its ability, and the ability of our companies, to constantly renew and to continually invest to create new economic advantages.

The issue is that just at a time when the rest of the world is investing in their innovation assets we seem to be struggling. The global economy is being transformed by the rise of a new set of truly disruptive technologies – big data, the internet of things, nano-technologies, and additive manufacturing to name a few. Our future prosperity will depend on our ability to innovate to exploit the opportunities these create.

### **Traditional economic approaches will not unlock innovation**

Throughout the recession, economic policy making has been dominated by a debate of when and how quickly to cut the deficit. Very little attention has been paid to the changes which could potentially transform our economy and deliver growth.

Tried and tested approaches to economic policy making will not work in the current environment. Our economy is facing structural issues as well as a shortage of demand. This means that any Keynesian stimulus package would be unlikely to have a lasting impact on growth since the five structural issues identified above are also limiting factors for our economy. The monetarist solution of cheap cash and low interest rates has been tried and found wanting. Despite being at a historic low, interest rates are failing to drive growth since our financial system fails to channel these funds through to support innovation. Too many companies with the capacity to invest see a shortage of investment opportunities, yet those who need to borrow to innovate are poorly served by our system.

Rather than these traditional approaches we need to consider our economy as a complex system, prone to failure. Missing and misdirected investment, weak infrastructures, poor

quality institutions, missing skills and poor linkages can all disrupt how our economy brings together the components needed for successful innovation. Strong leadership as well as collective action is needed across the public and private sector to turn this around. Central to this will be the state embracing its role as an enterprising enabler of change.

## **Investing in the infrastructures which underpin innovation**

Given the structural issues in our economy, we need public investment to re-build the architectures which link our economy and underpin innovation:

- **Protection for science, research and technology spending.** The 2010 Spending Review rightly recognised the importance of public spending on research in driving growth and it is important that this area continues to be protected. But a focus on research is too narrow – investment in facilities and support for the commercialisation of new technologies is needed if we are to make the most of our strengths here, and best leverage public spending;
- **Building a digital infrastructure fit for an innovation economy.** Digital networks have impacted on all parts of our economy and this effect is only set to increase, placing new and currently unknown pressures on our infrastructure. Recent progress means that we have broad coverage of internet access, but we are behind on the next generation of high speed connections. This is an issue since these will unlock many new innovation opportunities. We need a sustained programme of public investment in this infrastructure as well as an enhanced digital inclusion agenda;
- **A regulatory regime capable of unlocking the opportunities of Big Data.** The ability to process vast quantities of information and to turn it into useful knowledge is an increasingly important driver of value and innovation across our economy. Personal data is rightly afforded strong legal protection. This is essential for building trust around data use, but these regulations also significantly limit the value that UK companies can extract from data, because they make it difficult to combine multiple sources. Public investment could help build new platforms which support the merging and analysis of combined datasets without putting personal privacy at risk;
- **A system of governance able to deliver what local areas need.** The commitment to strengthen Local Enterprise Partnerships (LEPs) is welcome. But, effort here will be wasted if it is not matched by a co-ordinated agenda to improve the environment within which LEPs operate. Local policy structures could be simplified and rationalised around LEPs, while central support for LEPs will also have to increase if they are to effectively support innovation in all areas of the UK;
- **Change is needed to ensure our financial system better channels funding to the organisations in our economy with the greatest potential.** Ultimately the performance of our financial system will depend on private sector development of

new business models to value and invest in innovation. It is essential that we grasp the opportunity presented by the new Business Bank and the currently nationalised banks to support this change. The Business Bank must exploit its low cost of capital to develop and test new instruments to promote lending to innovative SMEs.

## **A modern approach to industrial policy**

In recent years, UK industrial policy has enjoyed somewhat of a renaissance. It has returned to prominence with a new focus, shifting from largely unsuccessful attempts to alter the fortunes of declining industries and using incentives to move jobs around the country. The focus instead is on areas of economic strength, removing barriers to growth, building consensus for action and linking different public and private initiatives.

This change is important. But, industrial policy must also develop to focus on economic renewal and innovation in these areas. To support this, our research has identified seven ways in which innovation ecosystems tend to fail. We would expect any well functioning innovation ecosystem to perform strongly against all of these criteria, so any weak points should be priority areas for action:

- 1 Is the industry investing in innovation?
- 2 Does the industry have the infrastructure it needs to develop?
- 3 Is the industry well linked? (both internally and externally)
- 4 Does the industry have a strong mix of intermediary institutions?
- 5 Does the state operate as an enterprising enabler in this industry?
- 6 Does the industry have the capabilities to sustain its own development?
- 7 Are there system risks facing the industry, or are external factors creating new opportunities?

The provision in the 2013 Budget of a £1.8bn fund to support this industrial policy agenda was an important step forwards. However, spread over its ten year horizon and across at least eight industries, this policy will not be enough to deliver meaningful change across our economy. In addition to support for delivery, we will need to invest in a strong team of policy makers able to work across government and the private sector to build the capacity for this type of activity and to target investments.

But we must not limit ourselves to a focus on existing strengths at the cost of support for new areas of opportunity. Many of the markets with the potential to pull the UK out of recession do not yet exist. It is the emergence of these new markets which drives the key economic dividend from innovation.

Incremental improvements in products and services can be handled within existing markets. The market for a new, faster, or more energy efficient, car is very similar to that for existing cars. But radical innovations often do not fit existing frameworks. Totally new goods and services, new types of business models and new industrial processes create a demand for new types of economic relationships, underpinned by new markets.

In practice, markets are highly complex entities and their development can be prone to failure. They do not always form instantly, even when there is a potential supply and demand for a product. This is especially the case when products are either new, untested or complicated. Many markets form slowly over time, shaping both the way consumers engage with a particular product and how it is supplied. Most markets are highly complex social and economic entities, dependent on many individuals, organisations and platforms.

While market formation is a primarily private sector activity, the operation and choices of the public sector can transform how markets develop. An enterprising state which can strategically manage this area could help to unlock new opportunities for innovation across our economy. From analysis of existing markets and of five developing markets (tele-health, 3D printing, self-driving cars, peer to peer finance and low carbon energy), we have developed seven principles of market making:

- **Invest in business foresight, not only technology foresight.** Government should not solely focus on future technologies, but also seek to understand the needs and challenges faced by businesses. Focusing on new markets means looking at the business applications of future technologies and ideas, particularly those that meet current or potential economic need;
- **Support markets rather than trying to create them from scratch.** Government should not try to second-guess the private sector. Instead it should focus on supporting entrepreneurs who are experimenting with new technologies and business models, but are facing constraints and challenges around legislation, legal rights, or other policy issues;
- **Look to support changes in consumer behaviour.** The receptiveness of consumers to new ways of accessing services can be critical in the formation of new markets. The public sector can play a major role in ensuring the domestic market is receptive to new products and services;
- **Look beyond funding.** While the targeted use of funding is an important element of the market making agenda, many of the most important tools available to the state are broadly cost-free. The state as a legislator, regulator, a convener and an enforcement agent can be tuned to support the formation of new markets;
- **Work across the whole of government.** This is not an agenda that can be confined to one department. Unlocking the opportunities associated with 3D printing, for example, will depend on action across multiple departments and agencies;
- **Leadership matters.** Where the public sector has the confidence to invest in and support a new market it should embrace the opportunity. Many investments are likely to fail, either because they choose the wrong areas to focus, or because of implementation failures. However, fear of failure or criticism that investments may be in the wrong area must not result in muddled or confused policy making.

## Delivering public support for innovation in an age of austerity

The UK economy has a growth and innovation problem. If we are to recover from recession then the focus of this Spending Review must be on unlocking innovation. This will mean targeted spending to remove structural problems in our economy to ensure we can exploit the opportunities presented by new general purpose technologies. If we are to secure a lasting recovery, then it is essential that all parties place this innovation-led vision at the centre of their thinking about how to support our economy at the next election.

A change in emphasis will be required across the public sector. Economic policy must become consistently built around how to support innovation. This must include:

- Encouraging all public organisations to set out a clear view of how they support innovation in our economy – **an innovation audit of the public sector**;
- **A new approach to policy appraisal** which assesses the impacts of policies on our innovation ecosystem;
- Developing the **Regional Growth Fund to have a specific innovation remit**; and
- Consistent increases in the use of **tools to support innovative procurement** such as SBRI.

However, tackling the deep-rooted structural issues in our economy will also require a major programme of investment. It is essential that the 2013 Spending Review starts this process with a £2bn programme of investment in innovation:

- Science and research spending is a key public input into our innovation ecosystem. But the approach taken in the 2010 Spending Review to protect the science budget in cash terms masked cuts in capital funding, and created a false distinction between these activities and spending on technology or other investments that help us to exploit our science and research base. Instead we need a commitment to **keep public spending on science, engineering and technology constant in real terms**, implying a cost of £180m for 2015/16;
- In addition, the government should set aside a further £300m **to create the next set of world class university research facilities**. This programme should build on the current attempts to promote collaborative facilities partnerships between the public and private sectors of the UK Research Partnership Investment Fund;
- A sum of £100m could **double the current deployment of the next generation of domestic broadband connections**. If this was managed in a way to also support uptake and usage, this could help to ensure that we start to catch up to our competitors on this important agenda;

- Finally, investment is needed to ensure that public policy can deliver a sophisticated approach to industrial policy, and can ensure our firms are able to exploit the opportunities and develop markets around new disruptive technologies. This activity will require support from across government, and additional resources in three areas:
  - BIS – in order to ensure that the department can effectively focus on, and has the resources to lead this agenda, it must be protected from cuts in real terms. This would require **an additional allocation for BIS of £180m<sup>1</sup>**.
  - Regional Growth Fund – has developed as one of only a small number of large scale mechanisms through which central government can deliver effectively targeted investments. **A new £1bn round of investments with a specific innovation focus is needed.**
  - TSB – as the only organisation with the capacity to operate as a delivery body for this innovation agenda, the TSB is the natural home for this agenda. However, **this developed role will require a major increase in activity and we propose an increase in budget of 50 per cent, or £220m.**

It is essential that the 2013 Spending Review prioritises growth. This will depend on finding the £2bn to support this investment programme. To fund this, the government must choose between a modest delay in austerity measures, the roll back of expensive and ineffective economic policies and the broadening of the remit of the review.

The success of the government's fiscal consolidation will depend on economic growth. Our analysis suggests that if this investment helped to drive an increase in economic output of only 0.1 per cent it would have paid for itself through increased tax revenues within three years. In practice the success or failure of the government's economic policy will be measured in much greater swings in GDP. There is a case for delaying austerity measures to tackle these issues which are holding back growth.

To date, the coalition government have a mixed record on support for innovation. They have demonstrated an ability to support innovation and to tackle these issues in our economy through the Catapult Centre programme, funding for new models of capital partnerships between universities and business, the planned Business Bank and consistent increases in funding for the Technology Strategy Board as an innovation delivery agency. The attempt in the 2011 Research and Innovation Strategy for Growth to present many of these activities as part of a coherent ecosystems approach is also an important step.

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<sup>1</sup> This figure excludes the £5.5bn spend of BIS on Science, Engineering and Technology, already counted above.

However, the big spending decisions and major investments have too often lost sight of this subtle appreciation of what could unlock growth and innovation in our economy. Cuts in corporation tax, the re-introduction of enterprise zones, increasing capital allowances, the freezing of fuel duty, and small cuts in national insurance contributions are all very expensive policies which reflect an out of date understanding of our economy and are inherently wasteful.

A common feature of all of these policies is that they seek to tweak the costs of doing business in the UK. But, marginal changes in price will have little impact on innovation performance, or the attractiveness of UK companies as global partners for innovation. Innovation is about creating new and different products, services, processes, business models and areas of expertise. These are by definition unique, and therefore not price sensitive.

Alternatively, if the government are unwilling to unravel these policies or further delay austerity measures then the only option is to broaden the terms of the Spending Review. The sharpness of spending cuts across many areas of government makes it more difficult to free up public resources to invest. The government have committed to a specific cut in current and capital budgets for 2015/16, and the protection of spending on the NHS, schools and international assistance. Under this framework the £2bn investment programme will imply a further 1.1 per cent cut across other un-protected areas. The current reluctance to consider cuts in portions of these budgets increases the scale of the challenge.

Redirecting resources towards the priorities set out in this Submission has to be part of a bigger discussion on tax and spending which is beyond the scope of this report. However, the recent IFS Green Budget points out that significant sums could be raised by taking a more consistent approach to welfare benefits and by increased taxation of the well-off. For example, extending means-testing to some pensioner benefits such as the winter fuel allowance and TV licences could raise between £1.5 billion and £2 billion in 2015-2016, while increasing council tax bands for the more expensive housing could generate another £2 billion.

Half a decade on from the onset of the credit crisis, the UK economy is still failing to consistently deliver growth. An innovation led recovery is the only plausible route to sustained prosperity. Public policy must now remorselessly focus on removing the structural issues in our economy which are holding us back, and on unlocking the opportunities presented by new disruptive technologies.

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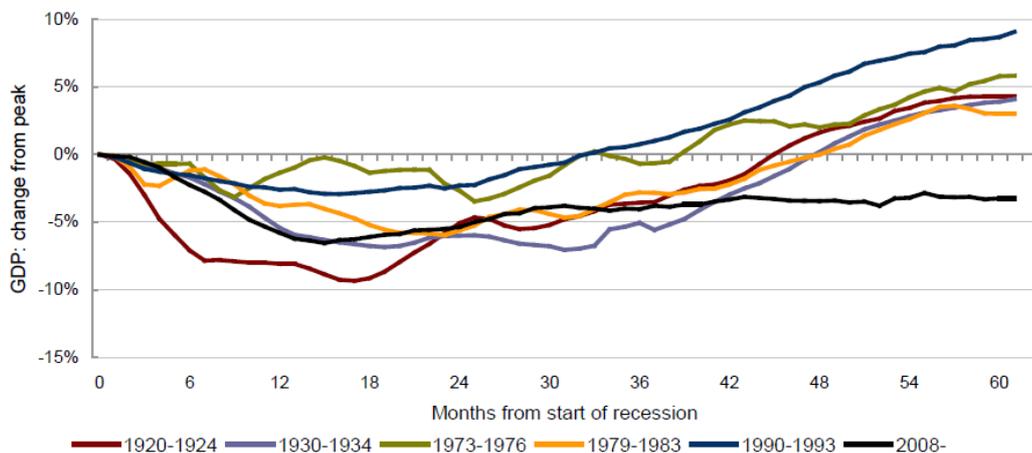
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## A manifesto for innovation and growth

We have called this Submission a manifesto for two reasons. Firstly, we are focused on the longer term. Not just the period left in this Parliament, but the five years beyond that when a new government – of whatever political make-up – will have to grapple with the same economic challenges as the current administration. Secondly, we believe there should be common ground across all of the major political parties on both the direction of travel and in some of the policy measures we set out later in this report. The structural problems the country needs to tackle require consistency, prioritisation and dedication that can survive changes in political fortune.

The primary challenge today is the economy. Five years on from the start of the credit crisis and we are still facing a contained depression. Economic growth has now been flat for three years, output is still well below 2008 levels, and even the more optimistic economic forecasts point to a weak and uncertain recovery over the next three years. In previous recoveries, the economy would be moving towards annual growth rates of 3 to 4 per cent. At best, we are looking at annual growth rates of 1 to 2 per cent. As a result, the UK has experienced the slowest recovery from a recession for more than 100 years – shown in the black line in the chart below.

**Figure 1: Recoveries from recessions**



Source: NIESR

Why are we facing such a problem? Firstly, co-ordinated fiscal austerity across much of the OECD has reduced demand both domestically and in key export markets. Indeed, much of the EU has recently fallen back into recession and as a result, devaluation has had very

limited impact on UK exports<sup>2</sup>. Secondly, both conventional and unconventional monetary policy instruments have been unable to fully offset the fiscal squeeze. Even alternative measures, such as “quantitative easing”, are reaching the limits of their effectiveness. Thirdly, economic crises triggered by financial collapse last longer and have more severe effects. Not only does the private sector try to reduce excessive levels of debt, but the economy remains hampered by dysfunctional capital markets. Facing exceptionally high levels of uncertainty at home and overseas, companies have been reluctant to invest. Longer term structural changes in the labour market - which pre-date the financial crisis - have seen an unprecedented fall in real wages during the recovery, in contrast to the post-recession norm where real wages rise.

Yet without a stronger recovery, any government will struggle to reduce public indebtedness. The constant danger is that we will become locked in a cycle of low growth, pushing up borrowing which then triggers a further round of austerity which continues to depress the economy.

The UK’s underlying growth problem cannot be fixed through a temporary cyclical boost to demand such as VAT cuts. The problems are structural rather than cyclical. Returning to the policy agenda of the 1980s of reducing employment rights, vague “wars” against business red tape, and recycling old ideas such as Enterprise Zones are equally irrelevant.

We believe we need to focus on three areas in order to move the economy onto a more sustainable growth path:

- A limited and targeted further relaxation of the austerity programme, focused on investment in capital projects and areas which will support longer term economic growth (even better if co-ordinated across the EU);
- Further efforts to address dysfunctional capital markets with a special focus on increasing both the demand for and the supply of funds to innovative companies;
- The development of the government’s emerging industrial strategy around creating markets and strong institutions so that the UK can take full advantage of the current and next generations of general purpose technologies (see box in the next section).

The common theme to all three areas is that they must focus on how they can boost the UK’s innovation capacity. Exactly how important innovation is for growth can rapidly deteriorate into a debate akin to how many angels can dance on the head of a pin. What we do know is that innovation, however defined, is the single most important driver. With few other obvious sources of growth available over the next decade, its importance has greatly increased. Improving the functioning of the UK’s innovation eco-system has to be at the

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<sup>2</sup> And may be much less effective today than in the past in an economy like the UK where a high share of exports are in high to medium tech manufacturing exports and high value added knowledge services which are less responsive to exchange rate movements than more basic commodities, and standardised and lower value added manufacturing products

heart of both the current government, and the next government's, growth agenda.

This is not, however, just an alternative set of supply side measures. The demand side remains crucial. Some measures to address these structural issues will increase demand, such as investment in the physical and digital infrastructure and expanded programmes to invest in or preserve human capital. This in turn will have positive impacts on business confidence and the willingness to invest – especially in growth markets of the future. But we also need to think about how we can increase demand in many of these critical areas. Creating markets for innovative goods and services, and addressing the increasing demand from innovative firms for finance and the knowledge that resides in our world class universities, are just as important.

General purpose technologies (GPTs) may sound obscure, but they are the key driver of long term growth. These are the pervasive technologies which will impact across our economy and drive change. In 2011<sup>3</sup>, we set out how general purpose technologies have shaped the economy we live in today and how, through key growth areas such as data analysis and big data, increasing demand and new technologies in healthcare, the low carbon economy or the opportunities presented by 3D printing, we can drive growth in the future.

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<sup>3</sup> Andersen, B. et al. (2011) Making the UK a global innovation hub

## The UK's growth and innovation problem

The UK is now almost totally reliant on innovation for growth. There is a real risk however, that the UK is failing to build on its innovation strengths at a time when innovation is becoming an increasingly global phenomenon. Structural issues in our economy are holding us back, and may prevent us from exploiting the opportunities presented by the next set of disruptive technologies. Prior to the credit crisis, consumer debt, financial speculation, property inflation and government spending drove growth. The credit crunch and the global recession have stripped our economy bare and revealed the significance of these structural issues.

### An innovation system in stasis

The UK has an incredible stock of innovation strengths, but half a decade on since the start of the recession these are still failing to deliver growth. In terms of academic record, UK universities are second only to the USA.<sup>4</sup> Overall, the UK is a good environment for business – the World Bank's 'Doing Business' database ranks the UK as the seventh easiest place in the world to conduct business.<sup>5</sup> This is reflected in the presence of some incredible companies: 30 British companies feature in the Fortune 500 ranking of the world's largest companies, and British businesses are industry leaders in many areas including healthcare and pharmaceuticals, advanced manufacturing and finance. Internationally investing and procuring firms also consider the UK to have a good business environment relative to its competitors.<sup>6</sup>

London holds an enviable position as one of the most important places in the world to raise finance. Our business services sector is incredibly strong, and leads the world in terms of its capacity to export, but it also works as an underpinning infrastructure, supporting the rest of our economy.<sup>7</sup> The UK is recognised as a naturally creative place, and our creative industries are very good at capturing this expressive value and are a key resource for

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<sup>4</sup> Seven UK institutions featured in the 2013 Times Higher Education World Reputation Rankings top 50. The only country to feature more prominently was the USA.  
<http://www.timeshighereducation.co.uk/world-university-rankings/2013/reputation-ranking/range/01-50/page/1/order/rank%7Casc>

<sup>5</sup> World Bank, IFC (2013) Doing Business 2013

<http://doingbusiness.org/~media/giawb/doing%20business/documents/profiles/country/GBR.pdf>

<sup>6</sup> Sameen, H. and Lee, N. (2013) "Econometric analysis of four waves of international procurement and investment decisions: A report for UKTI", Big Innovation Centre

<sup>7</sup> Sissons, A. (2011) "Britain's Quiet Success Story", Big Innovation Centre

innovation across our economy.<sup>8</sup>

Beyond these historical strengths, the UK is well positioned to exploit opportunities around a number of the disruptive technologies discussed above. UK universities are world leaders in elements of nano-technology and genetics, our strong design industry should be well placed to find new ways of working with the rise of additive manufacturing and 3D printing, and the structure of our health service under a single NHS should allow us to develop as a test-bed for new approaches to healthcare and health data management.

Despite these incredible assets it seems that large parts of our innovation environment fail. We do not seem to be very good at connecting these assets to deliver for vital consumer growth markets. This matters since we need to rely on innovation to renew our economy.

The UK economy is relatively weak in the fastest growing and most innovative consumer markets, including clothing and consumer electronics. In most of these key consumer growth markets, the UK runs a substantial trade deficit, and growing demand in these areas is increasingly being met by imports, rather than domestic production. Put simply, we do not seem to be very good at making the things that people increasingly want<sup>9</sup>.

The UK has a poor track record as an exporter to high growth markets such as China or Brazil<sup>10</sup>. OECD analysis also highlights that we have poorly managed to capitalise on growth in the markets which we already trade with. Their analysis confirms that since 2000 UK exports have grown approximately 20 per cent less quickly than imports into the markets we compete in.<sup>11</sup> While this pattern has been repeated across many developed economies, the UK appears to be losing market share at approximately two times the average OECD rate.

Equally worryingly, it is possible to trace examples where we are missing out on potential new markets, despite initial UK advantages, such as the graphene example in the box below.

### **Grasping graphene?**

The development of graphene has been made possible by the work of two British-based scientists Andrei Geim and Kostya Novoselov who were the first to isolate the molecule in 2004. This new wonder-material seems set to transform a broad range of existing technologies. It has a very rare combination of special properties. Electronic properties

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<sup>8</sup> Reid, B. et al. (2010) "A creative block? The future of the UK creative industries", The Work Foundation, [http://www.theworkfoundation.com/DownloadPublication/Report/277\\_277\\_A%20creative%20block.pdf](http://www.theworkfoundation.com/DownloadPublication/Report/277_277_A%20creative%20block.pdf)

<sup>9</sup> Thompson, S. (2012) "Consumer Habits and Innovation: How do our spending decisions shape the economy?", Big Innovation Centre

<sup>10</sup> Exports to BRIC economies for example still make up only eight per cent of UK exports (ONS Pink Book)

<sup>11</sup> OECD Economic Outlook, Volume 2012 Issue 2 - No. 92 OECD 2012

include high conductivity and a special structure which can support experimentation and testing with other molecules. It is a perfect thermal conductor. It is harder than diamond, but much more robust and stretchable. It is a visible material, unlike many thin structures, and is an inert material.<sup>12</sup> This means that its industrial applications are likely to be incredible – futurologists have predicted these could range from building aerials to support high bandwidth mobile connections, to batteries which can charge in just a few seconds, or filters that take cleaning of drinking water to new levels.<sup>13</sup>

However, recent patent analysis conducted by Cambridge IP confirms that the UK is far behind China, the US and South Korea in terms of related patent filing.<sup>14</sup> While the significance of the patents held by different countries may vary, the scale of the difference (54 published in the UK compared to 2,204 in China, 1,754 in the US and 1,160 in South Korea), does suggest that the UK has been left behind in this market.

There have been a number of recent announcements of funding for UK research in this area (such as the £61m National Graphene Institute in Manchester and the £30m Cambridge Graphene Centre). However, these investments may well be coming on line too late. The overall impression from the patent record is that the graphene market is one where we are running to catch up with the rest of the world, despite originally leading the world on the science.

Data on investment in innovation in the run up to the recession should force us to ask some major questions about how innovation opportunities are viewed. Figure 3 illustrates that at a time when corporate cash was increasing (2000-2007), investment in innovation as a share of GDP levelled off. This is in sharp contrast to the trend of the previous thirty years.<sup>15</sup> We should be very concerned about the fact that businesses were choosing not to invest in UK innovation.

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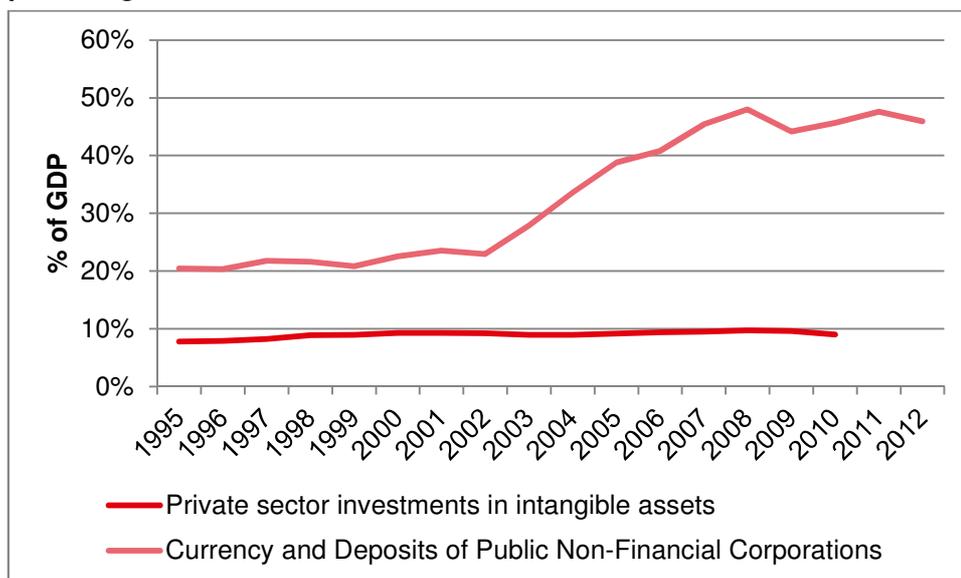
<sup>12</sup> Properties described based on <http://www.graphene.manchester.ac.uk/story/properties/>

<sup>13</sup> Horn, L. (2013) "9 incredible uses of graphene", Gizmodo

<sup>14</sup> [http://www.cambridgeip.com/media/M0006\\_BBC\\_Graphene\\_PR\\_15Jan2013\\_FINAL.pdf](http://www.cambridgeip.com/media/M0006_BBC_Graphene_PR_15Jan2013_FINAL.pdf)

<sup>15</sup> HM Treasury (2007) Intangible investment and Britain's productivity: Treasury Economic Working Paper No. 1

**Figure 3: Estimates of UK corporate cash and investments in intangible assets as a percentage of GDP**



Source: Big Innovation Centre calculations based on Corrado, C. et al. (2012). "Intangible Capital and Growth in Advanced Economies: Measurement Methods and Comparative Results" available at [www.INTAN-Invest.net](http://www.INTAN-Invest.net), and ONS

This apparent contradiction, incredible innovation assets, but a poorly performing system, is the result of structural failures within our economy. Ultimately, every innovation depends on new knowledge, resources to develop it and a market connection. The economy is an environment in which individuals and organisations operate and link to one another. Taking an ecosystems approach involves looking at how public and private institutions, banks, firms of all sizes and individuals populate and operate within this environment. We need to look both at the fundamental health of these parts of our economy and how these organisations link to each other. From this perspective, it is possible to identify real issues in regards to the way in which innovation in the UK operates.

**Our financial system supports property investment and failing firms but must better cater for our innovators**

It is widely acknowledged that innovative SMEs contribute directly to the economy and play an important role in productivity, competition and growth. However, due to weak demand caused by poor growth prospects for the UK economy since the crisis, innovative firms face greater cash flow constraints. As internal cash flows are reduced, external sources of finance become critical for the survival and growth of innovative firms. The reduced liquidity in the financial system – again, partly as a result of the crisis – has exacerbated underlying difficulties which innovative firms face in accessing finance. These are particularly acute for young and small firms. The issue is structural and relates to the allocation of capital through the financial system: some of the most innovative and highest growth firms find it difficult to access finance.

Analysis confirms that the financial system promotes economic growth through the quality of

capital allocation, not the overall rate of investment.<sup>16</sup> Thus, it is vital for sustainable economic growth that the financial system funds high growth and innovative firms. There is evidence to suggest that the UK has a risk-averse financial system and is thus more 'innovation unfriendly' than most. For instance, the UK's venture capital market provides 18 per cent of total funds raised for seed capital and start-ups, whereas the US market targets 59 per cent of all VC funds at the bottom end of the market.<sup>17</sup> Recent research commissioned by the Department for Business, Innovation and Skills also found clear evidence of on-going tight credit supply conditions for bank lending since the financial crisis, and higher margins on lending even after controlling for risk.<sup>18</sup> This may reflect a greater risk-aversion, in part due to newly introduced regulatory changes on capital adequacy as well as current market pressures to shrink bank balance sheets.

Confirming this picture, recent analysis from the Big Innovation Centre demonstrates that innovative firms struggle to get funding compared to other firms, and that this has worsened since the crisis<sup>19</sup>. In contrast to the experience of these firms, there appear to be a group of companies who find it easy to access funding. The Bank of England has recently expressed concern in its Financial Stability Report (November 2012) about the potential of forbearance lending or 'zombie' lending in the UK, but also noted that its true nature and extent is difficult to quantify due to insufficient information.<sup>20</sup>

It appears that our financial system is performing particularly poorly at its core function, the allocation of capital. When too many of a banks' borrowers turn out to be insolvent, a bank becomes insolvent. Because of limited liability, insolvent banks have an incentive to roll over bad loans, in order to hide losses and gamble for resurrection, even though this is socially and economically inefficient. An insolvent bank faces incentives to continue to lend to what are in practice insolvent firms so as to prevent actualising losses on their balance sheets, while hoping for an improvement in the situation of these firms. Bailing out banks to protect deposit and bond holders can also play an important role in strengthening such incentives.

This situation of waiting for resurrection is sometimes called "zombie lending" or "forbearance lending". If many banks engage in zombie lending, then the resulting misallocation of credit towards insolvent borrowers that should go bankrupt and are kept alive can have damaging consequences for productivity. There is anecdotal evidence suggesting that in the UK, due to historically low interest rates and the impact of bank bailouts, struggling 'zombie' firms continue to receive financing at the expense of higher-

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<sup>16</sup> See Levine, R. (2005), "Finance and Growth: Theory and Evidence", Handbook of Economic Growth, in: Philippe Aghion & Steven Durlauf (eds.), Chapter 12, pp 865 – 964

<sup>17</sup> Brinkley, Levy and Sameen (2012) "Autumn Statement Submission", The Work Foundation

<sup>18</sup> BIS (2013) "Evaluating changes in bank lending to UK SMEs over 2010-12 – Ongoing tight credit?", BIS Economic Papers

<sup>19</sup> However, we find that this is because there has been a general worsening of credit conditions rather than specific new problems for innovative firms since the financial crisis. For further details see Lee, N., Sameen, H. and Lloyd, M. (2013) "Credit and the crisis: Access to finance for innovative small firms since the recession", Big Innovation Centre

<sup>20</sup> Bank of England, Financial Stability Report, November 2012

growth and innovative firms. Many have cited this as a possible answer to the UK's productivity puzzle.<sup>21</sup>

The broader issue is that our financial system is strongly geared towards investment in property and real estate rather than in innovative activities. Our research suggests that only two per cent of the capital raised in the financial system is used to fund innovative activities.<sup>22</sup> The effect of this is compounded by the fact that large companies in the UK are reluctant to invest within the UK even though they are holding large surpluses and cash in deposits.<sup>23</sup> Many of these companies are cutting investment in the UK, using these cash-piles to pay off their debt while expanding in overseas markets.

### **We need to upgrade the poor management skills which are holding back innovative UK firms**

There has been a long-standing critique of the general level of management skills in the UK workforce. While we have had elite management development institutions – particularly some key business schools – for decades, the overall quality of British management has been assessed as poor, particularly when compared with US or German provision and skill levels.

A depressingly-established litany of official calls for improved general management education in Britain can be traced over the decades. These stretch from Harvard Business School's Michael Porter in 2003 who called for a shift in the UK's attempts to compete on cost, to one of value and innovation. However, he felt this task would be held back by low management skills<sup>24</sup> – through the 1987 report by Constable and McCormick for the CBI<sup>25</sup>, and to the 'Owen Report' of 1971.<sup>26</sup> Porter's key call, for 'a systematic strategy to raise the education of managers' is arguably still missing, despite some major investments by the Labour Government in the 2000s in this area. Although, as the *Institute for Employment Studies*' Penny Tamkin concludes in a review of the studies on British management skills, hard data on international skill comparisons is difficult to come by. The circumstantial evidence is of a persistent management gap between the UK and its international competitors, with neither government nor private sector efforts proving able to narrow that gap.<sup>27</sup>

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<sup>21</sup> Broadbent, B. (2012) "Productivity and the allocation of resources", Bank of England Speech given at Durham Business School

<sup>22</sup> Sameen, H. (2013) "Two spheres that don't touch", Big Innovation Centre

<sup>23</sup> Citi Research, UK Economics Weekly, April 5, 2013

<sup>24</sup> Porter, M. and Ketels, C. (2003) "UK Competitiveness: moving to the next stage", DTI Economics Paper No. 3: ESRC, [www.esrc.ac.uk/\\_images/UK\\_competitiveness\\_tcm8-13559.pdf](http://www.esrc.ac.uk/_images/UK_competitiveness_tcm8-13559.pdf)

<sup>25</sup> Constable, J. and McCormick, R. (1987) "The Making of British Managers: A report for BIM and CBI into management training, education and development", Corby: British Institute of Management

<sup>26</sup> Owen, T., Casey, D. and Huskisson, N. (1971) "Business School Programmes: the requirements of British manufacturing industry", London: British Institute of Management and Council of Industry for Management Education

<sup>27</sup> Tamkin, P. (2004) "Management Capability and Performance", Brighton: IES,

The concern is that those organisations which are most vital to the UK's recovery appear most likely to be damaged by any shortfall in national management skills. Research suggests that between 2007 and 2010 a mere seven per cent of 'high-growth', typically innovative firms created half of all new jobs.<sup>28</sup> But more recent research by The Work Foundation's Neil Lee indicates that while only 27 per cent of 'normal' firms thought management skills were holding back their growth, 41 per cent of these crucial 'high-growth' firms see a shortage of management skills as a key obstacle.<sup>29</sup> Management skills development – focused on ensuring these potential high-growth firms are not constrained by management skills shortages – looks therefore to have a strong link to the UK's job-growth potential in the next 10 years.

The challenge is that innovations are carried forwards and taken to scale by public and private sector organisations. If these organisations are held back by poor management or leadership, this then holds back innovation.

### **Public and private investment is needed in the infrastructure for growth**

The LSE Growth Commission, led by Tim Besley and John van Reenen, identified major gaps in the UK's road, air, rail and energy infrastructure<sup>30</sup>:

- Roads – despite the 2006 Eddington Review identifying an increasing congestion problem which could cost £22bn per annum by 2025, there remains no strategic thinking or commitment on how to improve our road infrastructure;
- Aviation – is held back by constrained airport capacity in the South East with the UK's two major hub airports, Heathrow and Gatwick, suffering from some of the most delayed flights in Europe – a quarter of flights here are delayed by over 15 minutes;
- Rail – is characterised by a poor reliability record by international standards. While there is a long term commitment to high speed services, few plans are in place to alleviate the key economic issue of passenger overcrowding at peak times, especially in the South East;
- Energy – successive UK government have failed to offer the confidence needed to attract private investment in our energy infrastructure at the scale required to modernise our network.

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<sup>28</sup> NESTA (2011) "Vital Growth", London: NESTA.

<sup>29</sup> Lee, N. (2011) "Free to Grow? Assessing the barriers facing actual and potential high growth firms" London, NESTA, [http://www.nesta.org.uk/publications/reports/assets/features/barriers\\_to\\_growth/](http://www.nesta.org.uk/publications/reports/assets/features/barriers_to_growth/)

<sup>30</sup> LSE Growth Commission (2013) "Investing for prosperity: Skills infrastructure and innovation"

These missing infrastructures are holding back growth, whilst in the past year we have seen a dramatic slow down in the construction sector which is heavily dependent on infrastructure spending. If clear frameworks were in place for infrastructure, private investment in these capital schemes would be much higher, potentially making up for dramatic cuts in public capital spending. In addition, putting in places these infrastructures would underpin a broader range of economic activities.

### **The institutional support for innovation must become less fragmented**

In his review of the UK's institutional support for innovation, Herman Hauser concluded that we are failing to capitalise on our science base.<sup>31</sup> The presence of predominantly poor quality and small scale intermediary institutions is holding us back. Intermediary institutions are organisations which occupy a space in-between academic research institutes and companies, although the concept can apply more broadly to other bridging institutions. They act as hubs, helping to link organisations that might usually find it difficult to work together.

Hauser found our arrangements here to be 'sub-critical'. It is not that the UK lacks these bridging organisations, or that we under-invest in them. But, Hauser used this phrase to explain that spending was too thinly spread across a large number of weak institutions. This challenge should be seen as a major cause for concern and cuts to the heart of the problem with the UK's innovation ecosystem. We have many brilliant organisations – businesses, universities and entities such as the BBC, but we lack the economic equivalent of connective tissue which can join these up to build networks, to share knowledge of challenges and opportunities and to drive innovation.

Partly in response to this review, the Government have established a £200m programme to build a new class of intermediary institutions under the Catapult Centre brand. This scheme is an important investment in the UK's innovation infrastructure and will form a core element of future growth policy. However, in comparing these plans to international good practice, our research suggests that these initiatives may lack scale and ambition, and may be too focussed on working with universities rather than businesses.<sup>32</sup> If they fail to reach a critical mass, then these centres will not have helped the UK to move beyond a weak and fragmented institutional landscape.

### **Local structures of economic governance need to become less chaotic**

Innovation does not take place in a vacuum. It depends on networks, relationships, and interactions between people, businesses and institutions. These are all, to some extent, rooted in particular places, and dependent on locally rooted institutions.

We need strong local institutions across the country to underpin local systems of innovation.

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<sup>31</sup> Hauser (2010) The current and future role of technology and innovation centres in the UK <http://www.bis.gov.uk/assets/biscore/innovation/docs/10-843-role-of-technology-innovation-centres-hauser-review.pdf>

<sup>32</sup> Andersen, B. and Le Blanc, E. (2013) "Catapult to Success: Be ambitious, bold and enterprising", Big Innovation Centre

These need to be able to remove the barriers to growth faced by innovative firms by ensuring that the wider conditions for innovation are met. At a local level this means consistently delivering the basics of place-shaping by ensuring a sufficient supply of housing, high quality schools, skilled labour, transport infrastructure and a well maintained public realm.

But, these innovation ecosystems also vary between cities, as places have different strengths and each innovate in very different ways. Illustrating this variety, Big Innovation Centre research<sup>33</sup> has mapped UK cities into a five part typology:

- **High performing innovative cities** – are highly productive, specialised in a range of knowledge intensive innovative sectors, and benefit from a concentration of skilled labour. This set of cities includes London as well as other cities located near London in the Greater South East: the cities of Guildford, Oxford, Cambridge, Peterborough, Southampton and Swindon.
- **Service sector innovators** – have highly productive economies but are specialised in high tech services and business services activities. They include the cities of Milton Keynes, Glasgow, Manchester, Reading and Bristol.
- **Technological innovators** – generate significant economic output and are specialised in high tech manufacturing activities. They include Coventry, Derby, Northampton, Preston and Warrington. These high tech clusters are often anchored by one large global firm, such as BAE in Preston or Rolls Royce in Derby and Coventry.
- **Innovative potential** – may have some strong niches, but do not yet have strong innovation ecosystems. They are places where we have identified some strengths but if they are to become successful they have challenges to overcome. This set of cities include: Gloucester, Birmingham, Ipswich, Sunderland, Newcastle and Worthing.
- **Low innovation cities** – are those cities which have failed to sustain innovative firms and adjust to the knowledge economy. These cities include ex-coalmining cities (Barnsley, Mansfield), seaside towns (Blackpool, and Hastings), port towns (Hull, Birkenhead, Plymouth and Middlesbrough), ceramics (Stoke-on-Trent) and textile manufactures (Bolton, Blackburn, Huddersfield and Rochdale).

This diversity creates a need for different places to be strategic in their approach to supporting innovation. Especially in an era of scarce public resources, there is a need to prioritise. For example the delivery of networks to support one specific industry, a whole manufacturing sector or a services specialisation might look very different.

This diversity creates a real need for strong local institutions across the country, capable of building networks and diverting resources towards the most important projects for an area,

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<sup>33</sup> Crowley, L. (2012) Streets Ahead: What makes a city innovative, Big Innovation Centre

including skills and infrastructure investments. They must be able to identify where infrastructures and resources are available, and to ensure they are maximised and tuned to local needs.

The recent work of the North East Independent Review offers one vision of how a Local Enterprise Partnership (LEP) could act to support innovation in its area:

- Scrutinise and support the development of policy impacting on the area including City Deals and European Investment Plans; and
- To build a new set of institutions (termed Open Innovation and Growth Hubs) to help bring together private companies and angel investors in three areas of North East strength: the biomedical industry, advanced manufacturing and sub-sea and offshore engineering.

These are recommendations rather than policy. Nevertheless, this thinking places the North East LEP in a select group of LEPs with clear ideas for how to support innovation in their areas. Many LEPs simply do not have the capacity or resources to bring forwards this type of work.

This lack of capacity is creating an urgent issue. Research from The Work Foundation confirms that LEPs have been successful in securing meaningful business as well as local authority engagement. However, our work also revealed that many business leaders within LEPs are impatient and ready to walk away if LEPs do not make real progress on the ground soon.<sup>34</sup> The risk is that LEPs are being sold as a new class of local institutions, but many lack both the powers to influence their areas and the capacity to lead.

The Heseltine Review went further still. In its assessment of the landscape of local economic governance it was highly critical of Local Authorities as “not suited to the demands of the 21st century and in particular our need to pursue economic growth.”<sup>35</sup> The review welcomed the measures of the current Government to empower local areas through the establishment of Local Enterprise Partnerships (LEPs), City Deals, Rural Growth Networks, the Regional Growth Fund, Enterprise Zones, the New Homes Bonus, the Community Infrastructure Levy, Business Rates Retention, Tax Increment Financing, Devolving Local Major Transport Schemes, reform of the planning system, new community budgets and specific changes in London. Yet, Heseltine rightly recognised that this long list of initiatives reflects a fundamentally fragmented and piecemeal approach – a particular issue since the government inherited a confusing and complicated set of arrangements, characterised by overlapping responsibilities between multiple elected and un-elected local bodies.

In response to the Heseltine Review, the Government have committed to give LEPs more

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<sup>34</sup> Cominetti, N. et al. (2012) “The Business of Cities: The private sector, Local Enterprise Partnerships and growth”, The Work Foundation

<sup>35</sup> The Rt Hon the Lord Heseltine Thenford (2013) “No Stone Unturned in pursuit of growth”

powers. Funding to support their operations, tasking LEPs with developing multi-year strategic plans for their areas, creating a single pot of local funds under their control (as yet undefined, but likely to include funding for skills, infrastructure, transport and housing), and nominally allocating a majority of EU Structural Funds to LEPs will strengthen these new institutions. However, this falls far short of the much needed simplification agenda of local economic governance called for by the Review. It does not, for example, settle issues of the accountability and relationships between different local bodies, or bring the new initiatives from the Coalition Government listed above under the control of the LEPs.

To be effective, local bodies need to have the capacity to lead, or to join up initiatives to get the most out of investments and organisations in their area. But, especially in terms of leadership, the landscape remains weak and highly fragmented. In many places this may result in a failure to deliver the conditions for growth by innovative firms. Devolving more authority to local areas when sub-regional leadership remains this weak represents a major risk.

### **The need to build capacity for Open Innovation**

Successful innovation increasingly requires open collaboration between multiple stakeholders to address opportunities and challenges. Businesses, universities, banks, intermediate institutions and private citizens are finding new ways to pool their internal resources (knowledge, finance, people, market access, big data and IP). There is growing interest in ways for companies to pursue innovation activities beyond their organisational boundaries. New co-working agreements, acquisition of start-ups with interesting technologies and spinning out new developments into external companies are all collaborative approaches that appear to be becoming more important.

Organisations which can successfully master this agenda are reaping huge economic rewards.<sup>36</sup> However, there are many indications that the UK is finding it difficult to adapt to this increasingly important way of working. Big Innovation Centre research<sup>37</sup> has identified four types of barriers which UK organisations face when pursuing open innovation:

- Culture change – many firms continue to be sceptical or negative about external ideas. ‘Not invented here’ can be a real issue;
- Tracking performance – an overly-narrow approach to assessing cost-benefit analysis, and risk-reward. Open Innovation collaborations often create value for organisations in different forms and on different timescales for different stakeholders, which requires a broad interpretation;
- Learning to extract value from their environment – engaging in new risk-sharing projects, ventures and activities requires a subtle appreciation of the organisations within a network, which can prove difficult to develop;

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<sup>36</sup> Levy, C. and Reid, B. (2011) “Missing an Open Goal: UK Public Policy and Open Innovation”, Big Innovation Centre

<sup>37</sup> Golightly, J. (2012) “Realising the Value of Open Innovation”, Big Innovation Centre

- Confusion about strategy – an assumption within organisations (sometimes also promulgated by open innovation advocates) that if they look to be open, then ‘everything’ has to be open. Overcoming this requires that organisations understand that, while their default position should be to innovate openly, in many circumstances being more ‘closed’ for specific projects and actions will be crucial for success.

While many organisations have adapted well to respond to these challenges, our research highlighted that they remain a major obstacle to effective open innovation for many UK companies.<sup>38</sup> Focusing on university-business relationships, forthcoming Big Innovation Centre research confirms the challenges faced by organisations which are looking to engage in deep collaborations, rather than to simply share ideas.<sup>39</sup>

In the UK, these issues are exacerbated by an outdated approach to intellectual property rights. Focusing too narrowly on strong control of markets and exclusion can make some forms of collaboration, sharing, and user engagement difficult. The 2013 Enterprise and Regulatory Reform Act did introduce minor copyright reforms which could allow new types of collaborative licencing arrangements to be developed. Proposals for further support to design rights in the new Intellectual Property Bill may lead to another small step forwards. However, it will take radical change before the UK has a legal system which is designed to enable sharing and collaboration around intellectual property based on the rights of users.

### **The scale of the UK’s innovation challenge**

Overall, these are not marginal factors which dampen growth or slow progress. They are fundamental blocks within our economy which prevent investments in the right areas and the development of the organisations with the greatest potential. We are talking here about healthy businesses which can not access finance, firms with innovative ideas held back by weak leadership, missing infrastructures for growth, limited institutional support to join together our economy, chaotic local structures, and many organisations struggling to exploit the opportunities presented by important open ways of driving innovation.

These are long term structural issues. In the main, they are not a product of the financial crisis or the recession. However, the turbulent economics of the past five years have stripped bare our economy to reveal these weaknesses. In the boom, growth was flattered by an unsustainable bubble in consumer debt, government spending, and strong global demand. The abundance of cheap credit masked the fact that our financial system poorly allocated funding to innovative firms. In that environment even the weakest of organisations could remain stable. The scale of public spending masked inefficiencies in how it was used, especially when we look at the approach to supporting regeneration and innovation.

Under normal conditions these underlying structural issues in our economy would have been picked up. The automatic stabilisers of an open economy would have kicked in, our balance

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<sup>38</sup> Golightly, J., et. al (2012) “Realising the value of open innovation”, Big Innovation Centre

<sup>39</sup> De Silva, M. et al. (forthcoming), Big Innovation Centre

of payments deficit would have led to a sharp decline in the value of the pound and supply side issues would have driven up inflation in the UK. Yet the unique conditions in the global economy, such as the dramatic expansion of the global labour force and the exchange rate and foreign investment policies of some of our trading partners meant that these effects were not felt.<sup>40</sup>

That is no longer the case. These structural issues are now holding back our recovery. The UK needs a major process of structural reform built around an innovation agenda if we are to ever overcome these challenges. This change is essential if we are to grow, or even to maintain current living standards, since our economy now depends on innovation to drive growth.

### **The increasing importance of innovation to the UK economy**

Recovery from the recession and improving living standards will depend on the performance of innovation in the UK economy. The past thirty years saw a shift in the UK where we now pay our way in the world from selling knowledge and technology, and less from manual labour or physical assets. This shift has allowed living standards to rise, but it has also inextricably linked our economic prosperity to our ability to innovate and to exploit the opportunities presented by new general purpose technologies.

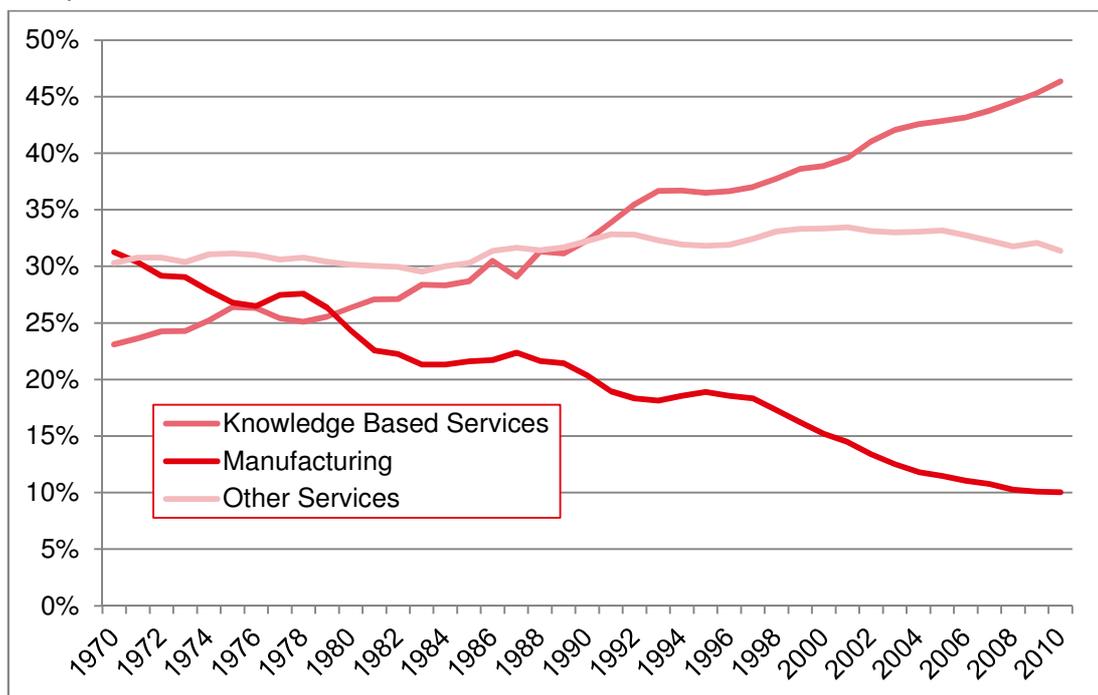
It is important that the economic challenges of the last five years do not obscure our understanding of the driver of value in the UK economy over the past 30 years. As the chart below illustrates, the UK economy dramatically restructured towards creating value from knowledge based services. We also now pave our way in the world through knowledge economy exports: between 1987 and 2006, the value of the UK's knowledge-based service exports grew from less than £13 billion to just under £90 billion.<sup>41</sup>

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<sup>40</sup> This has been explored in detail for the US (See for example Wolf "Global monetary and fiscal disorder: The role of global imbalances", Buro of Labour Statistics <http://www.bis.org/events/conf080626/wolf.pdf>) however the situation for the UK is analogous.

<sup>41</sup> Levy, C. et al. (2011) "A plan for growth in the knowledge economy", The Work Foundation

**Figure 3: Economic restructuring towards knowledge based services (GVA, 1970-2010)**



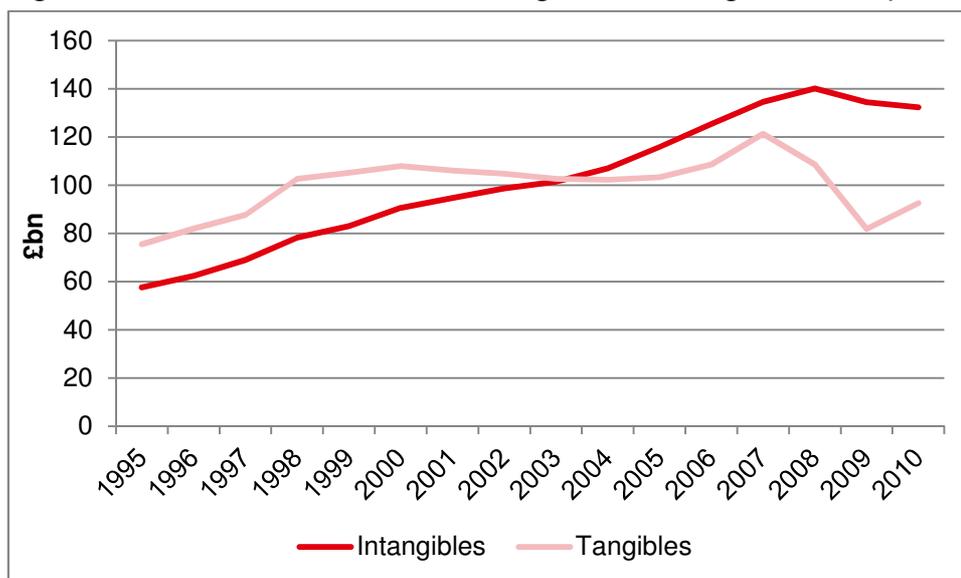
Source: EU KLEMS Database

In the 30 years up to the recession, we estimate that our economy created more than seven million net new jobs in knowledge intensive industries, making us one of the most knowledge intensive economies in the world.<sup>42</sup>

We also know that the impact of the knowledge economy reached wider areas of the UK's economy, and not just those sectors thought of as knowledge intensive. Business investment in all areas of the economy has been transformed. Figure 3 shows how this has moved from 'old economy' tangible assets of machines, buildings, office hardware, towards 'intangible' knowledge based investments including R&D, software, design and development, and human and organisational capital.

<sup>42</sup> Levy, C. Sissons, A. and Holloway, C. (2011) "A plan for growth in the knowledge economy", Big Innovation Centre

**Figure 4: Private sector investment in tangible and intangible assets (1995-2010)**



Source: Corrado, C. et al. (2012). "Intangible Capital and Growth in Advanced Economies: Measurement Methods and Comparative Results" available at [www.INTAN-Invest.net](http://www.INTAN-Invest.net) and ONS

With the rise of the knowledge economy comes a new reliance on innovation. Commercial advantages in a knowledge economy are temporary. New business models, new services, the principles behind new patents, designs, and industrial process drive value, but can to some extent be either copied or built upon. In a knowledge economy, the challenge is to constantly innovate as to stay ahead. Our ability to continuously drive innovation in turn depends on 'lock-in' factors which help to anchor innovative and knowledge intensive activity in a particular place. Networks of related organisations sharing ideas, specific institutions, pools of highly specialised labour, the intrinsic creativity of a workforce or the knowledge needed to deliver the next generation of research on a topic are all factors which advanced economies will have to rely on to continue to drive innovation.

#### **Innovation, growth and the UK economy – much more than productivity**

Innovation is the creation and application of new knowledge for benefit. This means the successful exploitation of new ideas:

- Innovation comes in many forms: new or significantly improved products (goods or services), processes, marketing techniques, organisational methods in business practices, workplace organisation or external relations all constitute forms of innovation.
- Innovation does not only refer to radically new ideas: radical and revolutionary innovation may have the greatest immediate societal impact, but innovation is also about incremental improvements.
- An idea that is new to a firm rather than a new invention also counts as innovation – and can have significant benefits for that firm's productivity.
- Innovation can mean adopting ideas from elsewhere: innovation does not have to be

devised in situ. The ability to draw on a variety of sources of knowledge and exploit ideas created in other city regions, universities and firms is critical.

- Innovation is important to all sectors: Whilst often associated primarily with science and technology, innovation is in fact a major economic driver within all sectors of the economy.

**Reference point: OECD (2005) Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data**

Despite this simple notion of innovation, measuring its contribution to growth is highly problematic. A common approach has been to model the economy based on the value of output compared to inputs of capital and labour. Any gains in output without corresponding increases in inputs are termed changes in Total Factor Productivity (TFP) and are attributed to innovation. This is often described as ‘the growth in output over and above the duplication’.

On this basis, the latest estimate is that between 2000 and 2009 increases in TFP were responsible for 32 per cent of labour productivity gains. Investments in intangible assets (which reflect a key component of investment in innovation) contributed a further 19 per cent. The implication is that innovation was responsible for driving approximately half of labour productivity growth.<sup>43</sup>

However, this technical approach significantly understates the central role innovation plays in the renewal of our economy. On a micro level a great deal of innovation can occur with only minor impacts on total productivity. Productivity measures poorly reflect the quality improvements which arise from innovation. As the economy and business models become increasingly reliant on intangible assets, investment in intangible assets has been increasing over the last decade but is not counted as value added to the economy. Productivity measures underestimate their effect on productivity.<sup>44</sup> However, we also know that firms that invest in intangible assets tend to smooth their innovation expenditure over the business cycle because they face higher adjustment costs as laying-off knowledge workers (50 per cent of all R&D expenditure is used to hire highly skilled workers) reduces firms asset base through which future profits will be generated.<sup>45</sup> The result is that firms will tend to reduce production but maintain investment in intangibles and retain knowledge workers. Thus, the skill level rises, since intangible investment typically requires high qualified workers. Its measured output falls, since the output of e.g. R&D projects might not manifest itself for a few years. Thus productivity falls, in a pattern that looks just like labour hoarding.

Also, a company could innovate to hold its position in the market without necessarily increasing productivity. And, simply adding more resources to our economy, or changing what we do can involve innovation without changing productivity.

Our economy is constantly changing through churn. In a typical year, 28 per cent of jobs are either created or destroyed as firms expand or contract.<sup>46</sup> This is central to how our economy renews itself and exploits new opportunities. Innovation plays a huge role here, far beyond the direct

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<sup>43</sup> Goodridge et al (2012) “UK Innovation Index: Productivity and Growth in UK Industries”, Nesta Working Paper No. 12/09

<sup>44</sup> Goodridge, P, Haskel, J. and Wallis, G. (2013) “Can intangible investment explain the UK’s productivity puzzle?”  
[http://www.ceriba.org.uk/pub/CERIBA/IntanUKProdPuzzle/Intangibles\\_and\\_Growth\\_Puzzle\\_7Feb13a.pdf](http://www.ceriba.org.uk/pub/CERIBA/IntanUKProdPuzzle/Intangibles_and_Growth_Puzzle_7Feb13a.pdf)

<sup>45</sup> Hall, Bronwyn and Josh Learner (2009) “The Financing of R&D and Innovation”, *NBER working paper 15325*, Cambridge MA

<sup>46</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/32244/11-1326-job-creation-and-destruction-uk-1998-2010.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/32244/11-1326-job-creation-and-destruction-uk-1998-2010.pdf)

impact on productivity that will occur if the growing firms are more productive than those which they are out-competing.

For example, a computer chip manufacturer which is expanding to increase production would not necessarily drive a significant change in productivity but it will have to constantly innovate to deliver growth. Hiring new staff and bringing in new machines will almost inevitably require changes in how existing staff work, how teams are structured and how tools are shared. New entrants into an existing market will have to innovate their way around potentially even greater challenges.

Solving these (often rather mundane) challenges may result in a firm developing something totally new which gives it a competitive edge, or just replicating what has been done elsewhere. Even where this involves the adoption of ideas from elsewhere, it is innovation if these ideas are being applied in a new context.

In this way innovation is central to almost all forms of economic growth.

## **A global race for innovation**

A number of commentators have suggested that the potential for advanced economies to grow through innovation has fallen and that there has been a decline in the return we can expect from new innovations. Tyler Cohen, writing in his book 'The Great Stagnation', argues that the economic crisis was masking a deeper challenge to advanced economies. He argues that growth in rich-world economies has been slowing because we have used up the cheap resources of free land, immigrant labour, and powerful new technologies. Having used up these resources, they are now not available to drive further development.

Robert Gordon has gone further to argue that recent innovations have been intrinsically less valuable and less powerful than in the past. Taking a stylised view of economic growth since the 1750s, he presents innovation as a series of discrete major inventions. Major new ideas such as steam engines, cotton spinning, railroads, electricity, the internal combustion engine, running water and indoor plumbing drive our economy and are followed by incremental improvements to tap their full potential.

His analysis, however, suggests that the latest set of new major inventions has not had as large an impact on our economy as these past inventions. Most controversially, he suggests that the economic impact of the computer and internet revolution petered out as much as ten years ago. To illustrate his point, he famously asked an audience to choose between access to historical inventions (running water, internal plumbing and flushing toilets) and the innovations of the past decade (Facebook and an iPhone).

If these innovation doubters are to be believed then this would represent a very significant test to the potential of the UK economy. However, these propositions do not stand up well to thorough scrutiny. It is incredibly difficult to measure the value created by innovation. In particular recent innovations, particularly in digital areas, appear to be associated with significant level of consumer surplus – benefits which consumers get from a product over and above what they are forced to pay for it. While individuals benefit greatly, companies

struggle to capture and monetise this benefit. For example, the nature of the internet has made it very difficult for content creation companies to capture the value they create.<sup>47</sup> The benefits from being able to access information, from being connected to family, friends and business contacts via mobile phones or through platforms such as Facebook create many highly intangible and difficult to measure benefits across our economy and society more generally.

These effects mean that the benefits of these innovations are significantly understated by traditional metrics. In contrast, however, revealed preferences suggest just how strongly individuals value this connectedness over traditional comforts such as indoor plumbing. In many parts of the world it appears that individuals are willing to pay for the intangible benefits associated with mobile phone ownership, but not for basic sanitation.<sup>48</sup> This is in direct contrast to the assertion Gordon and others put forward that these earlier elements are superior innovations.

Of greater significance than these technical arguments is the fact that the global economy is currently being defined by the rise of a set of new general purpose technologies. Each of these has the potential to transform broad areas of our economy. The scale of these opportunities and their abundance suggests that the global innovation is very much alive. The constraint is then not the availability of transformative technologies, but the demand for and capacity of the system to deliver.

#### **Emerging new general purpose technologies**

A small number of truly disruptive technologies will change how we work, how we make things, how we communicate and even how we care for ourselves. Over time these general purpose technologies (GPTs) become pervasive and widely applied across all sectors and types of business. GPTs all have the potential to create vast new sources of value, but also significantly disrupt how economic value is created today. They depend on rapidly advancing technology or areas experiencing breakthroughs.

Water and steam power were the GPTs of the industrial revolution. Petrochemicals and oil transformed the post war economy. The next set of GPTs will change things again. The places best equipped to respond to these challenges, the locations which innovate the fastest to exploit these opportunities, will prosper.

GPTs share some important common characteristics: they tend to begin as fairly crude technologies with a limited number of uses and they evolve into much more complex technologies with dramatic increases in the range of their use across the economy and in the

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<sup>47</sup> This is a topic explored in detail in the Big Innovation Centre report Sissons, A. (2011) "The Big Digital Dilemma: How should we pay for the web?"

<sup>48</sup> UN News Centre (2013) Deputy UN chief calls for urgent action to tackle global sanitation crisis <http://www.un.org/apps/news/story.asp?NewsID=44452&Cr=sanitation&Cr1=#.UXQGOaKG0iN>

range of economic outputs that they help to produce. As they diffuse through the economy, their efficiency is steadily improved. As mature technologies, they are widely used for a number of different purposes, and have many complementarities in the sense of cooperating with many other technologies.

Any technological change requires alterations in the structure of the economy that often proceed incrementally, more or less unnoticed. Sometimes, however, major new GPTs cause extensive structural changes to such things as the organisation of work, management of firms, skill requirements, location and concentration of industry, and supporting infrastructure.<sup>49</sup> GPTs that require such structural transformations can, in the short-term, result in a slowdown of productivity growth as the diffusion of a new GPT requires complementary inputs and learning, which may draw resources from normal production activities and may contribute to future productivity in a way that cannot be captured easily by current statistical indicators. Another reason why the diffusion of a new GPT should reduce growth in the short run is by inducing obsolescence of existing capital in the sectors it diffuses to.<sup>50</sup> At the Big Innovation Centre we have been working with our partners to understand the landscape of emerging GPTs through a series of interactive workshops. We have focused on four areas likely to yield disruptive technologies which will change our economy in the next few years. While it is difficult to predict these technologies accurately it is unlikely that we could prosper as an economy if we are not successfully exploiting these opportunities:

- Big Data – increasingly massive datasets are changing how organisations in all industries take decisions;
- Internet of things – has the potential to fundamentally change how humans relate to machines;
- Nano-technologies – are yielding a new class of materials unlocking technical opportunities across all industries; and
- Additive manufacturing – also known as 3D printing has the potential to change the global location of manufacturing activities and the relationship between manufacturing and design.

Many more areas have been proposed as potential new GPTs such as next generation genomics, advanced oil and gas exploration and recovery, renewable energy and energy

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<sup>49</sup> Lipsey, RG., Carlaw, KI. and Bekar CT. (2005) "Economic Transformations: General Purpose Technologies and Long-term Economic Growth", OUP: Oxford

<sup>50</sup> Aghion, P., Akcigit, K. and Howitt, P. (2013) "What do we learn from Schumpeterian growth theory?", NBER working paper 18824, Cambridge: MA

storage.<sup>51</sup> The potential of our economy to capture value from the emergence of these technologies is a central theme of our work and this paper.

In addition to these opportunities, increased global investment in innovation will drive rapid change. Many more locations around the world are investing and have developed their innovation capabilities. The risk is that the UK may not benefit to the same extent from this set of opportunities because of increasing global competition.

### **Increasing global investment in innovation**

There is no single source for global investment in innovation, but research consistently shows an increasing trend. It also appears that in many locations this investment has gathered pace during the recession:

- Commercial research tracks a doubling in the R&D spending by the top 1,000 companies between 2001 and 2011 (Jaruzelski, B. et al. (2012) The 2012 Global Innovation 1000, Booz and Company, [http://www.booz.com/media/file/BoozCo\\_The-2012-Global-Innovation-1000-Media-Report.pdf](http://www.booz.com/media/file/BoozCo_The-2012-Global-Innovation-1000-Media-Report.pdf))
- The Indian government recently unveiled plans to open 200 new universities in the next 5 years. (Chauhan, C. (2012) 200 Universities across India, Hindustan Times: New Delhi <http://www.hindustantimes.com/HTNext/Education/200-universities-across-India-in-next-5-yrs-Sibal/Article1-846073.aspx>)
- Researchers at Battelle estimate that between 2011 and 2013 global Gross Expenditure on R&D will increase by over \$100bn or 7 per cent. This includes an increase of almost \$50bn in China (26 per cent), \$7bn in India (18 per cent), \$4bn in Brazil (14 per cent) and by less than \$2bn in the UK (2 per cent). (Gruber, M. and Studt, T. (2012) 2013 Global R&D Funding Forecast [http://www.rdmag.com/sites/rdmag.com/files/GFF2013Final2013\\_reduced.pdf](http://www.rdmag.com/sites/rdmag.com/files/GFF2013Final2013_reduced.pdf))

This is in sharp contrast to the UK experience. Survey evidence from NESTA and the UK ONS suggests that private investment in innovation fell by 15 per cent between 2008 and 2011 (NESTA (2012) Plan I, <http://www.nesta.org.uk/library/documents/PlaniES.pdf>).

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<sup>51</sup> For one perspective on these four areas see McKinsey Global Institute (2013), “Disruptive Technologies: Advances that will transform life, businesses and the global economy”, [http://www.mckinsey.com/~media/McKinsey/dotcom/Insights%20and%20pubs/MGI/Research/Technology%20and%20Innovation/Disruptive%20technologies/MGI\\_Disruptive\\_technologies\\_Full\\_report\\_May\\_2013.ashx](http://www.mckinsey.com/~media/McKinsey/dotcom/Insights%20and%20pubs/MGI/Research/Technology%20and%20Innovation/Disruptive%20technologies/MGI_Disruptive_technologies_Full_report_May_2013.ashx)

However, innovation is not like other goods and services. Competition does not work in the same way. When two places compete to export coal it is a simple rivalry. If a Chinese firm buys coal from Australia, Indonesia and all other coal exporters miss out on the opportunity. But innovation and knowledge relationships can be either rivalrous or complementary. For example, Chinese investment in automotive design could hurt French car makers through increased competition in the market. But equally, Chinese innovation to improve the efficiency of photovoltaic cells and to reduce their price could allow French car makers to improve their products by integrating these into their vehicles to increase energy efficiency.

The extent to which the UK can benefit from increased global investment in innovation will depend on the relationship we have with other innovation locations – strong trading and inter-personal relationships are important to ensure we can benefit. It is important that UK organisations are seen as true partners for innovation.

This is why the Big Innovation Centre used our launch report to call on businesses, policy makers and universities to work together to make the UK a global hub for innovation. For a small economy like the UK, we have to be able to link up and create value from innovation across the globe. It is vital that we operate as a true partner in increasingly global innovation networks. It is therefore a real worry that, as set out below, there are real problems with how the UK brings together ideas to drive innovation at present. It is this environment which appears to be failing in the UK.

## Traditional economic approaches will not unlock innovation

In the recession, economic policy making has been dominated by the debate over how quickly the deficit should be reduced. Much less attention has been focused on the changes which could truly transform our economy and deliver growth. Positions have tended to match a highly politicised and polarised view of the state and the economy.

The Chancellor has repeatedly set out a plan to deliver tight fiscal policy to very quickly bring down the scale of the budget deficit in order to allow the Bank of England to keep interest rates low, so that businesses can borrow to invest.<sup>52</sup> The opposition have instead called for a slower rate of deficit reduction in order to support demand in the economy and potential stimulus packages. Yet, as the underlying issues facing our economy are structural, neither of these approaches are likely to deliver growth.

Our economy is facing structural challenges as well as a shortage of demand. This means that any Keynesian stimulus package would be unlikely to have a lasting effect on the growth rate. The monetarist solution of cheap cash and low interest rates has been tried and found wanting. Interest rates have now been at a historic low of 0.5 per cent since March 2009. Prior to the crisis, the Bank of England had never set rates below 2.0 per cent in its 300 year history.<sup>53</sup> Yet this has failed to unlock growth. The problem is not only a shortage of funds. It is that resources do not get through to invest in innovation. As set out above, too many companies with the resources to invest perceive a shortage of investment opportunities. Yet those who would need to borrow or raise finance are poorly served by our financial system.

Instead of these traditional approaches, we need to think of our economy as an incredibly complex system, prone to system failure. Missing investment, weak infrastructures, poor quality institutions, missing skills and poor linkages can all disrupt how an economy brings together the components needed to deliver successful innovation. Strong leadership as well as collective action is needed across the public and private sector to turn this around.

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<sup>52</sup> This idea was a central theme of the Chancellor's 2010 Emergency Budget Statement [http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/junebudget\\_speech.htm](http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/junebudget_speech.htm)

<sup>53</sup> Bank of England historic interest rates <http://www.bankofengland.co.uk/monetarypolicy/Pages/decisions.aspx>

## The power of an enterprising state to unlock private innovation in the UK

It is almost impossible to understate the importance of the public sector in overcoming these structural issues in our economy. While it is primarily business innovation which has the potential to drive our recovery, firms do not innovate in isolation. Every innovation is a unique combination of new ideas, resources to back the idea and some sort of market connection.

In a modern knowledge economy such as that of the UK, we need to think of the public sector as an enabler, capable of supporting the development of strong systems of innovation. The public sector is too often thought of as a monolithic block delivering static and routine processes. In reality much of the work of the public sector is highly knowledge intensive<sup>54</sup> and can be highly innovative. Common to most innovate areas of our economy, the public sector appears to invest more in intangible assets (a proxy for investment in innovation that covers research and development and intellectual property as well as human and organisational capital) than fixed assets. This investment could be as high as £50bn each year.<sup>55</sup> This figure is greater than the OBR estimate of general government gross fixed capital formation,<sup>56</sup> and examples such as the recent plan to spin out the 'Behavioural Insights Team' from the Cabinet Office through a private venture highlight the true value of some public sector teams.

In many areas, the boundary between public and private sector activities can directly help to stitch our economy together and mitigate the structural issues in our economy discussed above. Public procurement can encourage the acceptance of the new as well as the development of innovative new technologies and products. Publicly supported educational, creative and cultural institutions, such as museums, art galleries, libraries, design and art schools and the BBC, play a major role in the knowledge economy through the creation of expressive value and their position as knowledge hubs. If used carefully, public data can be a driver of value across industries. Successful examples include the land registry, the post code address file and Ordnance Survey data, but we believe there is potential to go much

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<sup>54</sup> Compared to private industry, public sector employment is characterised by a greater share of employment in knowledge intensive services, a larger share of the workforce qualified to degree level, employment more concentrated in the three most knowledge intensive occupations and a higher proportion of workers describe their work as including at least some knowledge tasks.

<sup>55</sup> Levy, C. (2011) "Making the most of public services", Big Innovation Centre

<sup>56</sup> OBR (2013) "March Fiscal and Economic Outlook", Office for Budgetary Responsibility

further.<sup>57</sup>

Public influence over higher education institutions can determine how these organisations work with companies. By sharing facilities with companies, the public sector can enable industries to leverage new types of infrastructures, such as the UK's national synchrotron facility.<sup>58</sup> Clarity over regulatory arrangements can help to unlock broad areas of economic activity.

As we look to cut public spending, there is a real risk that this vital support for innovation will be undermined. This is a real worry since it is this public support for innovation which should be focusing on bridging the gaps in our innovation ecosystem identified above.

The central challenge for this and the next government, however, should be to set out a credible deficit reduction plan, while also boosting this support. Success here will depend on the state fully recognising its role as a major player within the innovation ecosystem. The state must take an ambitious, enterprising and risk taking approach to delivering innovation led growth.

This will necessitate a three part agenda: delivering the underpinning environment needed by a modern economy, continued public action to support the development of areas of UK economic strength, and a new industrial policy agenda built up around making new markets.

## **Delivering an environment in which innovation can flourish**

All economic activity relies on a basic set of physical and organisational structures. The importance of good infrastructure such as road, rail and port connections, the presence of the right skills, or an effective legal framework are readily apparent for all types of economic activity. But a much more complex and specific set of conditions underpin innovation in an economy.

These innovation infrastructures help deliver inputs into our innovation ecosystem such as public research facilities which develop new ideas and knowledge for the economy. They deliver the funding and resources to pursue innovative new ideas and to bring new products and services to market, act as hubs of knowledge linking individuals and organisations within an economy and help to build conditions across the country in which innovative businesses can flourish and grow.

While the 2010 Spending Review offered protection for the science budget and a number of key institutions such as the Technology Strategy Board, many areas remain under-funded.

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<sup>57</sup> Sousa, S. (2013) "How should the government approach the big data challenge?", Big Innovation Centre

<sup>58</sup> UKTI (2012) "Business opportunities from Large Research Facilities: UK industrial and research capability serving the world "

This Spending Review should prioritise public investment in these infrastructures:

### **A bold and broad view of public investment in science, research and technology**

As our economy comes to increasingly rely on innovation and its knowledge economy, the need for investment in science funding and research facilities will increase. These activities should be viewed as an input of knowledge into the UK's innovation ecosystem. The incredible opportunities presented by new general purpose technologies such as new uses of digital technologies, genomics and nanotech will all require considerable research capacity to extract maximum value.

The contribution of the hard sciences to innovation has been well understood for many years. More recently we have been able to fully appreciate the contribution of non-STEM disciplines (science, technology, engineering and maths). The higher education sector in general has been doing a better job of mapping where it adds value, offering up case studies ranging from collaboration between social scientists with business engaged in risk modelling to the use of English literature to help support leadership development in SMEs.<sup>59</sup> The work of the Business Schools Task Force has identified and catalogued the many ways in which business schools work with medium-sized businesses.<sup>60</sup> From a recent major study of academics and their commercial partners, we now know that in a typical year nearly a third of academics from the Arts and Humanities are engaged with private sector business. And we know that compared to other disciplines, when business engage with academics from Arts and Humanities, they are more likely to be engaging in innovation activities. They are also more likely to have made major changes to their business structure as a result of the engagement.<sup>61</sup> Public investments across science and research can not wain.

However, the current ring-fence of the science budget has created perverse incentives which have put at risk important and related activities. This position is not sustainable. Instead, if we are to truly maximise the contribution of our research base to economic growth we need a broader view of how to protect public sector investment in science, research and technology.

The 2010 Spending Review went some way to recognise the role that scientific research plays in underpinning innovation in our economy and the £4.6bn science budget was protected in cash terms. But other related areas were cut dramatically. Investment in Research and Development by departments has fallen significantly faster than total spending<sup>62</sup>, and the 2010 Spending Review introduced a cut in capital investment in science facilities of £1.7bn. Up until 2010, the science budget had included this capital spending.

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<sup>59</sup> <http://www.itv.com/news/border/update/2012-07-06/business-leaders-to-learn-blue-sky-thinking/>

<sup>60</sup> Business Schools Task Force (2012) "Business School/Mid-Sized Business (MSB) Collaboration – supporting growth in the UK's mid-sized businesses", <http://www.bis.gov.uk/assets/biscore/further-education-skills/docs/b/12-1290-business-school-mid-sized-business-collaboration.pdf>

<sup>61</sup> Hughes, A. et al. (2011) "Hidden Connections: Knowledge exchange between the arts and humanities and the private, public and third sectors"

<sup>62</sup> Roland, D. and Cookson, C. (2012) "Big cuts to R&D budgets under spotlight", FT.com

This cut has now been largely reversed, through ad-hoc announcements (such as the £300m Research Partnerships Innovation Fund or the £50m National Graphene institute<sup>63</sup>). However, the experience shows that by focusing on a ring-fenced portion of spending, the rest becomes at risk of neglect.

This approach to the ring-fence also excludes other investments in research, development and application, reinforcing an artificial divide between so called 'basic' and 'applied' research activities. The approach implies a linear model of innovation and presents a view of government investing in new, abstract ideas with the hope that these will eventually trickle down, step by step becoming more and more practical until they become viable commercial propositions.

This is not how things necessarily work in practice. Ideas rarely follow neat paths from abstract concept to practical reality. Ideas interact. Suddenly, something which is of limited practical relevance in one area or organisation can transform progress in another. The value of an idea or a piece of knowledge is context specific. The development of a new business model can transform the value of knowledge. For example, search algorithms were useful and interesting from an academic perspective. But it was the linking of this technology to advertising business models that transformed its value.

Stepping away from a linear view of the application for science highlights the importance of investments which can help to ensure that the potential of academic research is realised. There is often a strong case for public investment around new areas of science to support, develop and test new business models, new technologies and the design and creation of new markets. It is this type of investment which can transform the value of new ideas. Governments have historically been weary of investments in these areas because they tend to be difficult to administer, and do come with risks of significant deadweight and displacement. However, it is not only basic research which markets consistently fail to deliver. This engagement with ideas, and cutting edge topics in practical ways is equally prone to market and system failures. These activities should not be treated as secondary by policy. In each area a complex and subtle balance of responsibility between public and private sectors is needed.

Rather than focusing on the science budget ring-fence, the government should commit to maintain spending on Science, Engineering and Technology in real terms.<sup>64</sup>

Unfortunately, maintaining spending will not be enough. Changes in how organisations innovate are creating a need for this public spending to yield a greater return. Open

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<sup>63</sup> The Campaign for Science and Engineering now estimate a net cut in public funding of UK science of £300m <http://blog.sciencecampaign.org.uk/wp-content/uploads/2013/03/Public-Funding-of-UK-Science-and-Engineering-%E2%80%93-March-2013-update.pdf>

<sup>64</sup> Estimates from the Department for Business Innovation and Skills place this investment at £10.2bn for 2010/11. Accessible here: <https://www.gov.uk/government/publications/science-engineering-and-technology-set-statistics>

Innovation is changing how we create value. Under this model, individuals, businesses and other organisations are finding new, closer ways to collaborate and address a business and social opportunity or challenge. In practice this means a shift from large private R&D labs, to a distributed and collaborative model of innovation. This will create new opportunities for the public sector to invest in science, research and technology. However, it also creates increased demands for public investment and will also require significant shifts in how the system operates.

The increasing practice of large companies looking outside of their organisations to drive their innovation activities exacerbates market failures and weaknesses around the trade in knowledge and ideas – these intangible assets are inherently difficult to value and trade. The traditional model of a large company pursuing basic research and developing this through to new commercial products appears to be increasingly rare. The implication is that the public sector needs to step in to plug an expanding gap in funding for basic research.<sup>65</sup> Given the current fiscal environment, additional resources are unlikely. This implies that public funding will have to become more effective, and better leverage in private, charitable and international funders.

UK universities appear to already be some of the most respected in the world at working with businesses.<sup>66</sup> However it appears that on the key issue of whether innovating business who use universities as a source of knowledge rate this relationship as highly important, the UK lags far behind the US.<sup>67</sup> To leverage maximum impact from our science base, investment should focus on schemes which can link researchers and the users of their work through genuine collaboration and open innovation.

Recent investments in Catapult Centres, through the UK Research Partnership Investment Fund, the Catalyst Fund and the Higher Education Innovation Fund point the way forwards here. These could be expanded and built upon in the future to further anchor our universities into local and national systems of innovation.

### **A digital infrastructure fit for an innovation economy.**

Digital networks have impacted on almost all areas of our economy. Many industries have been changed beyond recognition, as previously profitable businesses models have been fundamentally disrupted. Digital networks are also expanding and creating new sources of intangible competitive advantage. New approaches to firm strategy and positioning are emerging, as first mover advantages appear to be increasingly important. Organisational flexibility, ability to manage a network and other relationships are all increasingly significant

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<sup>65</sup> See Levy, C. and Reid, B. (2011) "Missing an Open Goal" for a full discussion of this trend.

<sup>66</sup> The World Economic Forum's Global Competitiveness report ranks the UK as second only to Switzerland for 'university-industry collaboration in R&D'. This indicator is based on perceptions of businesses on universities in their own countries. Schwab, K. (2013) "The Global Competitiveness Report 2012–2013", World Economic Forum. Accessible from [http://www3.weforum.org/docs/WEF\\_GlobalCompetitivenessReport\\_2012-13.pdf](http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-13.pdf)

<sup>67</sup> Abreu, A. et al. (2008) "Universities, Business and Knowledge Exchange", <http://www.cbr.cam.ac.uk/pdf/University%20Business%20Knowledge%20Exchange%20v7.pdf>

sources of competitive advantage in the digital economy.<sup>68</sup> The UK needs a high quality digital infrastructure if UK businesses are to exploit these advantages in the long term.

In terms of the proportion of organisations with access to broadband, the UK is on a par with many of our European trading partners.<sup>69</sup> The auction process of the 4G mobile communication spectrum, which allows much faster mobile connections, was finally completed in 2012 and recent reports suggest that a number of our cities will soon have strong mobile broadband coverage.<sup>70</sup>

The UK appears to be one of the most internet oriented economies<sup>71</sup>, and the increasing reliance on our digital networks shows no signs of abating.<sup>72</sup> However, the rise of a number of technologies could create even higher demands on our networks. The importance of data analysis and 'big data', connected devices through the 'internet of things', the needs of technologies such as 3D printing and cloud computing are all increasing and will place new demands on digital networks.

It seems that the rise of fast connections creates new uses and unlocks new business models, which in turn will create more demand for high speed connections. Recent trials of superfast broadband have hinted at what might be the different impacts of these higher connection rates. An interesting example of the transformative impact of improved broadband can have to unlock new business models is the case of a pub in Cornwall which is using its super-fast broadband connection to run 'tele-wine-tasting' events, connecting via video conferencing with vineyards in France and New Zealand.<sup>73</sup> Applying this at a city wide level, Chattanooga in the United States has been able to yield great gains from a superfast urban network running at more than forty times what is considered 'Superfast Broadband' in the UK. Yet much uncertainty remains around this area. We still do not know yet how consumers will change their use in response to new 4G mobile data networks. Google, for example, are investing hugely in offering incredibly high speed internet to two cities in the United States: Austin and Kansas City. But, we can say with confidence that having high speed networks with capacity to expand will be important if we are to innovate

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<sup>68</sup> See Andersen, B. and Wong, D. (2013) "The New Normal: Competitive advantage in the digital economy", Big Innovation Centre, for a detailed discussion of these changes

<sup>69</sup> Ofcom (2013) "The European Broadband Scorecard", <http://stakeholders.ofcom.gov.uk/binaries/research/broadband-research/scorecard.pdf>

<sup>70</sup> Garside, J. (2013) "EE to double speed of 4G mobile network in 10 UK cities", <http://www.guardian.co.uk/technology/2013/apr/09/ee-speed-4g-mobile-network>

<sup>71</sup> Boston Consulting Group (2012) "Clicks Grow Like BRICS: G-20 Internet Economy to Expand at 10 Per cent a Year Through 2016", <http://www.bcg.com/media/PressReleaseDetails.aspx?id=tcm:12-100468>

<sup>72</sup> Predictions of annual 40 per cent growth are common - [http://www.vodafone.com/content/dam/vodafone/about/public\\_policy/articles/internet\\_economy\\_uk.pdf](http://www.vodafone.com/content/dam/vodafone/about/public_policy/articles/internet_economy_uk.pdf)

<sup>73</sup> Brookings, P. (2012) "Will the UK really have the best superfast broadband in Europe by 2015?", <http://www.cbi.org.uk/media-centre/news-articles/2012/12/business-voice-will-the-uk-really-have-the-best-superfast-broadband-in-europe-by-2015/>

and exploit these opportunities.

It should therefore be cause for concern that the UK's digital infrastructure appears to offer broad, rather than high speed, coverage. The UK slips to 17<sup>th</sup> when ranked by the speed of broadband connections.<sup>74</sup> The EU Digital Agenda Scorecard ranks the UK poorly against our key competitors on 'next generation access and superfast' broadband. Our performance on the key high speed technology, of Fibre to the Home (FTTH), is abysmal. Only 200,000 homes in the UK could connect to this technology. France, Germany, Spain, Italy, and Portugal have all succeeded in building networks which are accessible to over a million homes. This should be a prime concern as currently FTTH is the only technology capable of delivering mass internet access at rates in excess of 1GB.

The government currently have a policy target to offer the best superfast broadband network in Europe by 2015. This is an important aspiration and it is essential that this focus on high speed connections is maintained in the long term. Policy makers can not be put off by the daunting task of forming the complex public and private partnerships needed. If the UK fails to embrace this next generation of internet connections then not only will we miss out on the opportunities for innovation discussed above, but we will also risk damaging some of our strongest industries. Without a home market which is using the latest technologies, how can we expect our creative industries, for example, to maintain their competitive edge?

Delivering this high speed infrastructure will require public attention to initially increasingly focus on cities. Here the public cost of delivering high speed internet connections can be dramatically reduced and the investment will be targeted at knowledge intensive businesses which have the greatest connection to innovation.

Innovation can and does occur anywhere, but it has a special relationship with urban areas and nodes of activity. These are the places where people meet, share ideas and exchange knowledge. Cities have historically been the sites of disruptive innovation as industries merge and ideas jump from one area to another.<sup>75</sup> Yet, many urban areas still have poor broadband performance.<sup>76</sup> A successful vision of future growth depends on the health of innovation in our urban areas. It is essential that this key infrastructure becomes available.

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<sup>74</sup> The Akamai Q3 2012 ranking score the UK 17<sup>th</sup>

<sup>75</sup> This is the central principle behind the seminal work, Jacobs, J. (1961) "The Death and Life of Great American Cities"

<sup>76</sup> Garside, J. (2012) "Fast broadband speeds not guaranteed by living in city centre, figures show", <http://www.guardian.co.uk/technology/2013/mar/27/fast-broadband-speeds-city-centre>

### **How much is needed to deliver the next generation of broadband connections?**

The most robust estimate of costs is that £12bn would be required to deliver FTTH connections to 70 per cent of UK homes<sup>77</sup>. However the costs of delivering this per home fall substantially in the most densely populated urban areas, potentially from the £700 per home suggested by this headline to a figure closer to £500 per home<sup>78</sup>.

An important first step would be to double the number of homes in the UK which could access this technology from 200,000 to 400,000. This would cost in the region of £100m.

Delivering this as a competitive fund could help to encourage innovation, the development of alternative service models and technical approaches and increase consumer uptake. It could also help to reduce the crowding-out of private investment in this area. However, given the very poorly developed nature of the UK market, this is less likely to be as significant an issue as it is for current programmes.

While investing in high speed connections for cities is essential, this will be redundant without a wider digital inclusion agenda. Our poor performance on the quickest broadband connections is not only a supply issue. In the few places where it is available, the uptake of FTTH is less than half that seen across the EU.<sup>79</sup> Perhaps of more immediate concern, it appears that small and medium sized UK businesses lag far behind both consumers in their use of digital technologies, and e-commerce in particular.<sup>80</sup> Digital skills appear to be a particular barrier. One report has found that a quarter of SME managers feel their business lack basic internet skills and two thirds of working-age no-internet users cite a lack of basic skills as a barrier.<sup>81</sup> A recent report also suggested that the market for broadband is held

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<sup>77</sup> Broadband Stakeholder Group (2008) "The costs of deploying fibre-based next-generation broadband Infrastructure", [http://www.broadbanduk.org/wp-content/uploads/2012/08/http\\_\\_\\_www-broadbanduk6.pdf](http://www.broadbanduk.org/wp-content/uploads/2012/08/http___www-broadbanduk6.pdf)

<sup>78</sup> This is a conservative estimate based on analyst calculations of Google's roll out of 1Gbps connections in Kansas <http://techcrunch.com/2013/04/08/google-fiber-cost-estimate/> and a proposal for the UK from Fujitsu <http://ovum.com/2011/04/15/ftth-in-the-uk-can-fujitsu-make-the-numbers-add-up/>

<sup>79</sup> Estimates of UK uptake are available here <http://www.thinkbroadband.com/news/5668-199-000-homes-passed-by-ftth-networks-in-the-uk.html> and for the rest of the EU here [http://www.ftthcouncil.eu/documents/Webinars/Webinar\\_14March2013.pdf](http://www.ftthcouncil.eu/documents/Webinars/Webinar_14March2013.pdf).

<sup>80</sup> Despite our leading position on retail, the UK is much closer to the EU average in terms of E-commerce [http://epp.eurostat.ec.europa.eu/statistics\\_explained/index.php?title=File:Turnover\\_from\\_e\\_commerce\\_broken\\_down\\_by\\_web\\_and\\_EDI\\_type\\_sales\\_2010\\_\(%25\\_of\\_total\\_turnover\).png&filetimestamp=20120410123816](http://epp.eurostat.ec.europa.eu/statistics_explained/index.php?title=File:Turnover_from_e_commerce_broken_down_by_web_and_EDI_type_sales_2010_(%25_of_total_turnover).png&filetimestamp=20120410123816). ONS data confirms that SMEs in the UK derive a much smaller proportion of their turnover from E-commerce than large companies. <http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcn%3A77-280897>

<sup>81</sup> Koss, V. (2012) "This is for Everyone: The case for universal digitisation", Go ON UK and Booz & Co

back by a poor understanding of the market by consumers.<sup>82</sup>

Through a focus on digital inclusion, policy could boost demand for high speed connections which will ultimately drive their delivery. However, given the urgent need not to fall further behind other economies, and the long lead times involved in physical infrastructure investments, we can not afford to wait for this market to be built organically. If we are to successfully exploit the opportunities presented by digital networks, we will need to build both the supply and the demand side of this market. A powerful digital infrastructure and the digital inclusion agenda can not be presented as competing priorities.

### **A regulatory infrastructure able to unlock the potential of big data**

The ability to process vast quantities of data and to turn it into useful information is an increasingly important driver of value in our economy. Often termed 'big data', it is almost impossible to understate the impact that this trend is having on our economy.

#### **The Opportunity of Big Data**

Big Data refers to any collection of large, complex, and diverse sets of data. The ubiquity of computing in modern life, the increasing processing power of these computers and the availability of cheap data storage has coincided with a surge in the existence of large data sets – IBM estimate that every day we now create 2.5 quintillion bites (18 zeros) and that 90 per cent of the of the data in the world today has been created in the last two years alone.<sup>83</sup> The increasing significance of data as an economic asset is both a product of the growth of data and a further driver of the trend.

The Big Data effect spreads far beyond traditional IT sectors. Businesses in every industry are increasingly using data to optimise processes, to boost efficiency and to take decisions.<sup>84</sup> Our research has identified a number of organisations using data to reduce labour requirements through the automation of processes, such as using algorithms to reduce the need for data entry roles. Data and digital technologies provide new ways for companies to learn about and interact with their customers, making it much easier for them to meet their needs. Companies involved in digital marketing, for example, have found success through the use of data to better connect to customers. Finally, data itself appears to increasingly be a source of new products and services as many companies look to market themselves as experts at data analytics.

In essence, big data is a new general purpose technology. It will change society in the same way as previous GPTs, the likes of railways, synthetic materials, electrification, mass production and the Internet. Although intangible, these technologies are instrumental in

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<sup>82</sup> Yiu, C. and Fink, S. (2012) "The superfast and the furious: Priorities for the future of UK broadband policy"

<sup>83</sup> IBM (2012) "What is Big Data?", <http://www-01.ibm.com/software/data/bigdata/>

<sup>84</sup> Bloom, N. et al. (2013) "Management in America", <http://www2.census.gov/ces/wp/2013/CES-WP-13-01.pdf>

every sector and function of the global economy today and are just like other essential factors of production such as labour, capital, energy and raw materials.

The information and knowledge embedded in big data will be key to long term competitiveness. Companies, societies and nations that understand how to build and combine their data with other networks of both public and private data will hold the competitive edge.

The UK has a number of assets which position us well to work with big data: the strength of our business services industry<sup>85</sup> and the highly analytical nature of our higher education provision in particular. But we must build on these if we are to be a leader in data. The public investment in the £10m Open Data Institute and the £10m annual public commitment to the Connected Digital Economy Catapult Centre will be of particular help by increasing the capacity of public and private sector organisations in the UK to make use of data. The recent Shakespeare Review and the Caldecott Review also made a number of positive recommendations which, if implemented, could improve how the public sector exploits its data.

However, a significant policy issue remains which, if left unchecked, will curtail our ability to create value from data. Multiple datasets need to be combined to find interesting and unrecognised synergies in order to unleash their full potential, but significant regulatory hurdles complicate this process.

Many of the greatest opportunities to exploit data will come from the sharing of data across contexts. The value of data depends on context. Sharing and combining data can change this context and allow new insights. Fire authorities, for example, illustrate the importance of using multiple sources of data. In Amsterdam, fire authorities have been able to combine data they hold on fire service incidents with government data on buildings, streets, roads, waterways and transport links to build new fire risk models. In the UK, the London Fire Brigade use a system which combines data on population and demographics from the census, public data on land use, deprivation, historic fire incidents, and past prevention activity as well as data from a private supplier on lifestyles for each of the 649 geographic areas they cover.<sup>86</sup> Sharing of data can help industries to learn from each other. For example, by engaging with data from other industries, companies can learn from experience tackling common issues.

Companies, societies and nations that understand how to build on and in particular how to

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<sup>85</sup> Sissons, A. (2011) "Britain's Quiet Success Story: Business services in the knowledge economy", Big Innovation Centre

<sup>86</sup> Graham, F. (2013) "Can big data help fight fires and save lives?", <http://www.bbc.co.uk/news/business-21902070>

combine their data with other networks will hold the competitive edge. But much of the most economically valuable data is personal and could be used to identify an individual. Personal data is rightly afforded a significant level of legal protection, which restricts processing and prevents sharing an individual's data between organisations without their explicit consent.<sup>87</sup> This is an important principle needed to maintain public trust in those who collect data. Without a strict consent regime many individuals would be unwilling to share their data at all. But, under current arrangements these restrictions limit the value we can extract from data.

There are many potentially important opportunities from sharing data which would not necessarily compromise privacy of individuals, but are prevented by current arrangements:

- Medical research – health care companies might be able to develop new drugs, or early interventions for dementia or Alzheimer's disease if they were able to combine data on the pattern of behaviour shown by internet browsing records and health trial data. Combining data can help to increase the speed at which research can occur and increase the likelihood that it reaches valid conclusions;
- Investment in energy efficient housing – through the Carbon Reduction Commitment, energy suppliers invest in household energy efficient improvements. If they were able to combine the data they already hold on energy consumption with public data on household characteristics they could have a better idea of the efficiency performance of a building and therefore how to target their spending;
- Traffic management – if planners were able to combine data on how individuals move around a system with information around why they choose to then the sophistication of modelling techniques could be improved;

The problem is that while the analysis could be person blind, in each of these hypothetical cases, joining together these datasets relies on being able to identify individuals. Analysis at an aggregate level simply is not as powerful.<sup>88</sup> Not only does this limit the potential of our data, it also presents particular issues for small organisations. They do not have the scale to share data across alternative services, or areas of their business. This could potentially reduce the contestability of markets and act as a brake on competition.

To date, debates on the issues of personal data have been highly confrontational. Challenges such as the issue of data sharing have been presented as a choice between economic growth and personal privacy.<sup>89</sup> However, in some areas there are possible

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<sup>87</sup> The principles of this protection are set out in detail in the 'Data sharing code of practice' from the Information Commissioner's Office  
[http://www.ico.org.uk/for\\_organisations/data\\_protection/topic\\_guides/~media/documents/library/Data\\_Protection/Detailed\\_specialist\\_guides/data\\_sharing\\_code\\_of\\_practice.ashx](http://www.ico.org.uk/for_organisations/data_protection/topic_guides/~media/documents/library/Data_Protection/Detailed_specialist_guides/data_sharing_code_of_practice.ashx)

<sup>88</sup> The case of the London Fire Brigade above illustrates this point – if it were possible to conduct this fire safety analysis at the level of individual buildings it would be more accurate than the current broad geographic areas.

<sup>89</sup> For example, a recent article from Damien Walter captures this divide well -  
<http://www.guardian.co.uk/books/booksblog/2013/mar/14/future-tech-big-brother-big-data-creator-culture>

changes in how data is held or used and technological solutions which can navigate us around this tension.

One option is to ask data subjects to agree to new uses for their data. Platforms to manage how individuals opt-in and out of data sharing arrangements offer one way forwards.<sup>90</sup> While public investment in the development of platforms such as these is important, these arrangements will take many years to develop and will require considerable changes in public attitudes before they become widely used.

But, in cases such as those identified above, the aim is commercial research rather than identifying individuals. This means that personal data issues represent an unnecessary hurdle. Investment in so-called 'zero knowledge systems' could offer a way for us to unlock more value from our data. These can be best thought of as a black box into which personal data can be added from multiple sources, analysed and the anonymised results of the analysis extracted.

Zero knowledge platforms are already in use in multiple commercial environments to allow for the testing of algorithms, and for authentication purposes. However, public investment is needed to develop these platforms to this purpose, to investigate the remaining regulatory hurdles and business models through which they could operate.

### **A system of local governance able to act to deliver conditions which can support local innovation ecosystems**

In response to the Heseltine Review, the government have now identified Local Enterprise Partnerships (LEPs) as the key local body to lead economic development. However, if they are to develop across the country as a new tier of institutions, capable of supporting innovation, then they will need significant additional support. There are real risks associated with devolving further powers, especially given the chaotic nature of the current landscape.

As discussed above the changes to financial support for LEPs, and confirmation around the development of multi-year strategic plans, the new 'single pot' and a major role with EU structural funds will help to strengthen LEPs, but they will continue to be held back by the challenge of operating in an unclear and fragmented landscape. If LEPs are to develop as successful organisations, then action is needed to build a better environment for them to operate in. There is much more that could be done to support these organisations in their development without stifling localism. The government could:

- Encourage LEPs and Local Authorities to work together to agree a clear set of joint working arrangements for interactions between LEPs, Local Authorities, Central

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<sup>90</sup> For example, a recent consortium project between Hewlett-Packard Laboratories, HW Communications, QinetiQ, the London School of Economics, the HeLEX Centre of the University of Oxford and the University of Warwick developed an architecture through which this could be managed without violating data protection guidelines.

Government and other public bodies. One model for how this might work was set out as part of the North East Independent Review;

- The selection criteria for the Regional Growth Fund could be developed to favour projects which can demonstrate clear working with LEPs; and  
Under the City Deal framework, the transfer of specific powers from central to local tiers of government is being negotiated. The authority of LEPs could be further strengthened if they were formally identified as leading partners for these negotiations.

Increasing the power and the capacity of LEPs to lead in their areas will create further risks. Establishing strong local institutions capable of delivering effective leadership is likely to create tensions between areas, especially in terms of competition for nationally managed funding. Competition between areas would be damaging if it started to pull jobs around the country or divert public investment away from where it might yield the greatest returns, a particular issue for items such as large research facilities. In setting their strategies to look at how they can support innovation, LEPs must consider their relationship with other areas, and the national significance of their innovation strengths. This will be especially important for either small LEPs or ones with overlapping geographical boundaries.

This is a challenge repeated in all countries and the ‘smart specialisation’ approach advocated by the European Commission offers a sensible way forwards here. The power of the approach advocated here is that it reflects not only the key innovation assets of a local area, but aims to place this in the context of neighbouring geographies as well as national and international patterns of specialisation and strength. This is essential if we are to avoid the all too common ‘me too’ or identikit strategies across the country.

Success here, however, will depend on a very tricky combination of bottom-up consensus building and top-down guidance to link strategies and to take a national perspective. To achieve this, LEPs will continue to need support to develop, as well as increased central resources to help them to take a national perspective.

### **Our financial system must change to better channel funding to the organisations in our economy with the greatest potential**

New business models are needed to meet the growth demands of a knowledge-based economy. The key for a financial system to support innovation is maturity transformation; that is, borrowing short and lending long. This requires trust, a lender of last resort, a wide diversity of assets, new modes of financing for firms with intangible assets, and an appetite for risk. The more the system can provide finance for relatively illiquid assets whose pay-offs may be both risky and long-term, the better it will support innovation.

However, financial intermediation has intensely changed over the last two decades. In particular, changes in the way institutions provide credit to corporations has been one of the biggest shifts. The traditional originate-to-hold model of banking has been replaced by the so-called originate-to-distribute model. Historically, banks originated loans and kept them on

their balance sheets until maturity. Over time, however, banks began increasingly to distribute the loans they originated. This caused banks to limit the growth of their balance sheets but enabled them to maintain a key role in the origination of corporate loans, and in the process contributed to the growth of non-bank financial intermediaries.

The long term solution will lie in the evolution of banking business models to respond to the reality of a modern intangible asset based economy. In a data-driven economy, banking business models are moving from traditional methods of banking to become knowledge-intensive service providers. Information is becoming increasingly valuable and banks could use this opportunity to expand their role in the financial ecosystem by becoming an added value information/knowledge broker to grow lending to fast growing innovative firms and sectors.

The government has the opportunity to facilitate this transition through the design and structure of its 'Business Bank'. At present, the remit of the bank is to join-up and deliver the existing programmes of the Department for Business, Innovation and Skills, with £1 billion (leveraged up to £10bn) for additional lending to innovative and high-growth firms. The rationale is that the bank will be able to access funds on more favourable terms than commercial banks (especially those that have a large share of bad debt on their balance sheets such as RBS), and will therefore have a lower cost of capital.

The Business Bank's lower cost of capital and remit to consider long-term social returns would allow it to make loans that would typically be avoided by commercial banks. In particular, it would be able to take a wider economic view of the benefits of investing in certain markets, including cases where there are potential long-term social returns from developing new technologies (such as green technologies). This would mean a particular focus on lending and investment for innovation, particularly to young and high-growth firms, which experience the most acute financial market failures and where the externalities will be greatest. Since this would include green technologies, there would be a case for including the Green Investment Bank into the Business Bank. In general, the government should build such a bank around its broader industrial strategy.

The Business Bank should go further and play an important role in creating a corporate bond market for SMEs. This would require a platform for SME loan securitisation along the lines advocated by the Breedon Report in 2012. Previously, we have proposed two tools which could help here. In our report entitled 'Credit where it's due'<sup>91</sup>, we proposed an SPV to enable SMEs to access the corporate bond market to raise finance. This bank could serve a similar purpose by bundling SME debt through acting as an aggregating agency. This would not only securitise SME assets and sell them on to investors, but by reducing risk exposure it could also use the proceeds for other business activities – to fund more lending, for example.

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<sup>91</sup> Hutton, W. and Peasnell, K. (2011) "Credit Where It's Due: How to revive bank lending to British Small and Medium Sized Enterprises", Big Innovation Centre

The Big Innovation Centre also recently released a provocation piece for another type of business debt finance – a ‘Flexible Project Investment’<sup>92</sup>, which is an innovative new instrument that banks can use to finance SMEs. An FPI is a series of project-based bonds, released to match the cash flow profile of a project. Not only can such alternative sources of lending step in to plug the gap left by conventional bank lending, there is also the potential to develop new markets for lending – projects that were previously considered unviable could become viable with the introduction of new lending technologies and risk management techniques.

By removing the requirement for investors to analyse the credit quality of many small issuances from individual SMEs, these platforms would relax SME financing constraints and kick-start institutional investment in these firms. Private banks would continue to operate as the frontline funders of loans to SMEs, offering facilities over an extended period – five or more years, say. However, they would be more willing to do so knowing that they would then be able to sell most of the loan on to the Business Bank, tying up far less capital against such liabilities. The state-backed institution would then group packages of such loans together to issue as securities on the corporate bond market. However, to be effective, the governance structure of the Business Bank has to be carefully set out to ensure that it is responding to clear economic incentives. The LSE has proposed that such a bank be run by an “appointed independent board to oversee operational decisions independently from BIS”. They also think that the bank should operate under a charter that clearly articulates its mission and ensures that it is held accountable for delivering that mission.<sup>93</sup>

These alternative forms of lending could be the disruptive technology that shake up banking business models to do better lending, as well as create new markets for lending. New alternative lending technologies and platforms such as these are needed to give businesses greater choice, promote competition amongst finance providers – potentially reducing cost, and to promote greater resilience in the financial system. Many countries, particularly the US, have a wider range of bank and non-bank finance options for businesses creating a more diverse and efficient market.

Finally, the government also needs to address the problems within the nationalised banks. At present, they are functioning poorly with high levels of impaired or problematic loans. This is impacting the efficiency of capital allocation which is in turn impacting economic productivity. The government needs to take a prompt and timely decision on how to deal with these banks, whether to nationalise fully (as opposed to having arms length control), or to sell off, or to split into a good bank or a bad bank. To date, the Treasury has been keen to insist that all options remain on the table for the future of the banks. It is beyond the scope of this paper to assess these options. However, we think that if the taxpayer continues to hold

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<sup>92</sup> Douglas, B. et al (2013) “Flexible Project Investments: A proposal for a new form of debt finance for SMEs”, Big Innovation Centre

<sup>93</sup> LSE Growth Commission (2013) “Investing for Prosperity: Skills, Infrastructure and Innovation”, Centre for Economic Performance, London School of Economics

majority shares in some of these organisations, they could make a greater impact through the full nationalisation of these organisations by leveraging their balance sheets, potentially through the Business Bank.

## **Sustaining recent progress on industrial strategy making**

The second component of effective public support for innovation is effective leadership in areas of economic strength. As well as putting in place the basic architecture for innovation across our economy, public policy also needs to focus to make a real difference. Recent years have seen the emergence of a subtle approach to industrial policy making. This is important and must develop to focus taking an ecosystems perspective to unlocking innovation in these areas.

Progress on industrial policy has been based on a focus on areas of economic strength, removing barriers to growth, consensus building, and linking public and private initiatives. This approach is essential if the public sector is to deliver meaningful support for innovation.

The types of policy being applied today are vastly different to the industrial policy of post-war Britain. In the past, the image of industrial policy has been badly damaged by a focus what were 'sunset' industries and attempts to use public spending to encourage economic activity to move around the country. Policymakers have been too ready to write off this implementation failure as a reason to avoid industrial policy.<sup>94</sup> Yet without a tight focus it is highly unlikely that policy can deliver meaningful support for innovation.

Analysis of the best performing innovation ecosystems consistently highlights a mix of highly specific public and private institutions and infrastructures underpinning the activity. For example, many studies have linked the spending the US Defence organisation, DARPA, to the success of Silicon Valley; or the success of the UK's cluster of motorsport companies to public sector expertise and the availability of public airfields for racing.

Clearly different industries innovate in different ways, creating varying demands on the public sector. No economy could hope to fund this deep institutional infrastructure across all industries. A strong prioritisation agenda and a focus on key areas are needed to deliver the specific elements of innovation infrastructure demanded by different parts of our economy.

In identifying eight industries to focus on, the Department for Business, Innovation and Skills has set clear targets. To date, they have delivered an industrial strategy for the nuclear industry and aerospace. These are two areas of real strength where the public sector can play a real role in helping to ensure that businesses can flourish.

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<sup>94</sup> For an extended discussion of this topic see Levy, C. and Lee, N. (2011) "Ready Steady Grow: How the government can support the development of more high growth firms", The Work Foundation

While this work is welcome, it is important that the next generation of industrial strategies build from a clearer model of how innovation operates in a particular industry. They must incorporate a true ecosystems perspective on what impedes innovation in that area and what could help to unlock it.

The Big Innovation Centre has developed a framework to test the health of an innovation ecosystem which can be applied to any area of our economy. The incorporation of such an approach into industrial policy could help to better target scarce resources.

The list below builds from our view of the key actors operating within an economy, and the seven ways in which we think that innovation ecosystems are prone to fail. By focusing on these seven areas, the current approach to industrial policy can develop and become more targeted on supporting change and innovation in our economy.<sup>95</sup> We would expect any well functioning innovation ecosystem to perform strongly against all seven of these criteria, so any weak points should be priority areas for action:

- 8 Is the industry investing in innovation?
- 9 Does the industry have the infrastructure it needs to develop?
- 10 Is the industry well linked? (both internally and externally)
- 11 Does the industry have a strong mix of intermediary institutions?
- 12 Does the state operate as an enterprising enabler in this industry?
- 13 Does the industry have the capabilities to sustain its own development?
- 14 Are there system risks facing the industry, or are external factors creating new opportunities?

Overall, industrial policy needs to continue to move from being about across the board hand outs, and more about targeted investments to support change. The provision in the 2013 Budget of a £1.8bn fund to support this industrial policy agenda was an important step forwards. However, spread over its ten year horizon and its effect across at least eight industries, this policy will not be enough to deliver meaningful change across our economy.

As well as delivering bold and well resourced strategies, the government needs to further prioritise their development. Speaking at the launch of the Annual Innovation Report in November 2012, the Business Secretary, Vince Cable, was in a position to stress the very limited resources available for this agenda – he had been able to free up only part of one member of staff's time to help pull together a strategy for the textile industry, for example. If this approach is central to how the government plan to restore growth in our economy, then we need a strong team of civil servants working across government to build the capacity for this type of work.

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<sup>95</sup> The Big Innovation Centre have been working with the BIS to develop a guidance tool to help build this standardised approach to thinking about an innovation

## Investing to ensure the UK creates value from making new markets

The payoff from supporting the renewal of existing industries, however, is limited. Perhaps the most important agenda for the government is to help unlock the new markets being created by new disruptive technologies. Our performance here will define the development of our economy.

Despite its importance, the sector-based approach to industrial policy detailed above carries a major risk. The focus on existing industrial strengths may come at the cost of support for new areas of opportunity and growth for the UK. The Big Innovation Centre has called for a new approach to supporting the development of new disruptive markets through an emphasis on market making.

### What is a market, and how do they form?

A market is a space where economic exchanges take place. A point where buyers and sellers interact.

In practice markets are highly complex entities. They do not always form instantly, even when there is a potential supply and demand for a product. This is especially the case when products are either new, untested or complicated. Many markets form slowly over time, shaping both the way consumers engage with a particular product and how it is supplied. Most markets are highly complex social and economic entities, dependent on many individuals, organisations and platforms.

Our research has demonstrated that their formation depends on a complex mix of public and private sector leadership, to put in place seven key building blocks:

- 1 **Technologies** – technologies often underpin the workings of a market. They need to be available, viable, and compatible with the wider infrastructure and institutions of the market.
- 2 **Infrastructure and locations** – markets almost always require some sort of physical infrastructure to bring buyers and sellers together, whether it is roads or broadband cables. They also need a location, whether it is a place or a digital domain.
- 3 **Standards** – markets often depend on having established standards which all players can follow, to allow them to be coordinated and achieve critical mass.
- 4 **Customer behaviour and conventions** – customer habits play a major role in shaping markets and determining value. Unless customers are willing to adopt new products and services, they will not take off.
- 5 **Supply chains and networks** – there is a wide range of structures and logistics which provide the ‘plumbing’ within a market. These structures often rely on relationships between many different firms.
- 6 **Regulation** – regulation on competition, on health and safety, and a range of other areas can help to create markets and build consumer confidence,

but it can also hold them back.

- 7 **Legal rights** – property rights – be they for intellectual or tangible property – play a central role in defining what is traded in a market, and enabling buyers and sellers to capture the benefits from what they exchange.

Reference Point: Sissons, A. and Thompson, S. (2012) “Market Making: A modern approach to industrial policy”, Big Innovation Centre

Incremental improvements in products and services can be handled within existing markets. The market for a new faster or more energy efficient car is very similar to that of existing cars. But radical innovations often do not fit existing frameworks. Totally new goods and services, new types of business models and new industrial processes create a demand for new types of economic relationships, underpinned by new markets.

It is the emergence of these new markets which drives the key economic dividend from innovation. New products and services do not merely represent new choices for consumers, they also create new demands. For example the demand for tablet computers was very low before the development of the Apple iPad. The development of a new product has transformed demand for tablet computers and built a new market for software. It is this ability to create new demand which is at the heart of how innovation drives growth. The formation of new markets is just as important an innovation process as the creation of new ideas or the testing and development of new technologies.

Unfortunately market formation is rarely straightforward. No two markets are ever alike and their development can be prone to failure. Where markets fail to form this holds back innovation and growth. We should be concerned that the UK appears to under perform at creating new markets.

The graphene example above is not an isolated example of Britain struggling to create value from incredible intellectual and economic assets. Our analysis has highlighted real British weaknesses in the UK economy’s connection to the fastest growing and most innovative consumer markets, including clothing and consumer electronics. The challenge is that growing demand in these areas is increasingly being met from imports rather than domestic consumption.<sup>96</sup>

Market making is predominantly a private sector led activity. Businesses are well placed to identify potential corporate or consumer needs and to bring together ideas, resources and capabilities to meet these. This is perhaps central to what it means to be a commercial organisation. However, the building blocks above highlight the importance of the public

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<sup>96</sup> Thompson, S. (2012) “Consumer Habits and Innovation: How do our spending decisions shape the economy?”, Big Innovation Centre

sector as a partner in creating new markets. Regardless of intent, it is very difficult for the public sector to remain neutral and not promote or hinder the development of new markets. As a major consumer, the government is often instrumental in setting the standards on which markets run. Public bodies such as the Office of Fair Trading and the European Commission play an important role in setting and enforcing the regulations on which markets depend.

Given the inevitability of this relationship, there is a clear case to be made for public policy to engage consciously in market making. In certain circumstances, the public sector may have a particular foresight or confidence about future developments not available to the private sector. This appears to be particularly the case in the market for low carbon energy supply. Finally, in some areas it may be in the interests of the public sector to actively support the creation of a new market, especially when connected to an industry dominated by the public sector such as health or education.

#### **Building a market around tele-health in the UK - Delivering Assisted Living Lifestyles at Scale (DALLAS) programme**

Tele-health is the integration of digital technologies and healthcare. Current applications vary from sophisticated new types of remote biometric sensors and complex IT systems, to the use of reminder text messages for medical appointments to reduce cancellations.

The area appears to show incredible potential to change how health services are delivered, in increasing the effectiveness of some treatments<sup>97</sup> and offering opportunities for value creation from innovation. For example, if the use of technology to manage a condition can increase the effectiveness of a pharmaceutical product, then the value of that drug will increase dramatically.

However, looking at UK experience, there appear to be a number of barriers which are slowing the development of this market, such as social and consumer reluctance to rely on un-proven technologies. This agenda cuts across a large number of existing markets (healthcare, lifestyle and technology) which are poorly linked, making collaboration difficult. The fact that many of the benefits from these technologies accrue to the users and un-paid carers means that health care payers (typically the NHS and local authorities) have not pursued them at full pace.

The £37.3m DALLAS programme however is an interesting example of the imaginative use of public procurement to help build a market in this area. Managed through the Technology Strategy Board and the Small Business Research Initiative (SBRI), the scheme uses NHS funds to purchase tele-health services for a large number of initial patients.

An example of the projects running would be the 'Warm Neighbourhoods' 'AroundMe Pilot' service which makes use of connected home sensor technology and remote monitoring systems to connect older adults or frail end users with their broader informal carers (typically neighbours and extended

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<sup>97</sup> Kings Fund (2012) "What impact does telehealth have on long-term conditions management?"

family).

The power of the approach is that the scheme takes a broad perspective, working across networks of patients, carers, health care providers, technology companies and other groups to help research, build and support markets capable of rolling out existing technologies across large areas of our health and social care system. The programmes have been designed to tackle the various barriers to the development of this market:

- Cuts across multiple agendas – a complex network of beneficiaries makes market formation difficult here. However funding via SBRI and through the TSB along with a sophisticated evaluation approach help to mitigate this.
- User acceptance – the programme is run at scale with high profile events (such as showcase events to recruit participants at a football stadium). These are aimed at building confidence and a community of users.
- Practitioner acceptance – many healthcare practitioners have been resistant to the introduction of some of these technologies because they have been perceived as crude management driven costs savings. The transparency around this programme appears to have reduced these concerns.
- Missing links and networks – the programmes have been designed specifically to bring together multi disciplinary teams. For example, one project involves five NHS and five private sector companies. This was achieved by using an extended networking event at an early point of the tender process to support collaboration. All of the project groups come together to meet regularly to share experience and learnings between the programmes.
- Interoperability of IT systems – a specific focus on testing ways around these platform issues was designed into the programme, such as integration with GP systems, and personal health records in the 'Health Vault' platform.
- Unknown business models – the programme has been designed to test multiple models for delivering tele-health and is also supported by a parallel stream of research on business models.

Note: the evidence presented here was gathered at a recent discussion event at the Big Innovation Centre: Disruptive Forces: Health Technology and Living Better. For more details please see <http://www.biginnovationcentre.com/Events/71/Disruptive-Forces-Health-Technology-and-Living-Better>

Market making is a very difficult agenda for the public sector to practically engage with. New areas where markets appear likely to develop, such as 3D printing, peer-to-peer finance, or nano-technology, are often characterised by conflicting and competing claims about the future of an industry, poorly developed networks and few effective representative bodies. Supporting the development of these markets can in many cases be contentious if it is disrupting value creation in other parts of our economy. For example, the contentious debate over IP reform in the creative industries reflects the fact that in some cases new markets

cannibalise existing areas.

The task for the public sector is further complicated by the fact that some of the most fragile and disruptive markets (such as 3D printing) are populated by small and medium sized firms which policymakers find most difficult to engage with. The temptation to focus simply on investments in new technologies is understandable. However the scale of the market making challenge is matched by the opportunity.

UK prosperity in 2025 will depend on our ability to capture a share of the new markets which form in the next decade. The effectiveness with which new markets form in the UK will determine the share of this new value that we can then capture. Our ability to create markets will also determine the value we can create from new technologies. In this way, the ability of the public and private sector to work together to support the formation of new markets will be central to our future economic prosperity.

There is no single policy measure which can promote and support strong performance on market making. However, looking across a number of new market areas, several themes emerge for how policy can go beyond a technology focus.

**Five potential new market areas and targets for market making:**

- 1. 3D Printing** represents an exciting opportunity for the UK to exploit our strong design industry through a new platform technology. The ability to fully automate the production of parts and components in a way which is both cost-effective and highly adaptable and flexible has the potential to change how our manufacturing industries develop new products. The effect will be greatest for organisations working in new areas, those with small production runs (often associated with high-value products) and those who look to constantly personalise and tailor their production to customer needs.

However, our research has highlighted a number of specific issues that will hold back the development of this market in the UK around intellectual property, regulation, legal responsibilities, common standards, as well as digital and physical infrastructure. Overcoming these barriers would benefit from collective activity between many areas of the public sector including BIS, the Intellectual Property Office, the Health and Safety Executive, the Department for Communities and Local Government and the Technology Strategy Board.

Sissons, A. and Thompson, S. (2012) "Three Dimensional Policy: Why Britain needs a policy framework for 3D printing", The Big Innovation Centre

- 2. Self Driving Cars** could transform how our transport systems work. The technology could bring enormous benefits to road users, from reduced traffic to increased road safety, or just more productive commutes as we do other things while we drive. The basics of the technology have been invented and a number of organisations such as

Google and BAE Systems are investing to make this a reality.

However, the market for self driving cars will be very slow to develop because of issues around cyber security risks, legal liability, the complexity of changing our existing networks (such as maintenance to keep pace with the new technology) and consumer acceptance.

Araujo, L. Mason, K. and Spring, M. (2012) "Self-driving cars: A case study in making new markets", The Big Innovation Centre

- 3. Peer-to-Peer Finance** offers an exciting opportunity to use platform technologies to directly link those individuals interested in financing companies, to companies looking for funding. The approach has the potential to unlock new models of banking for small companies and could represent a new way of valuing organisations and their potential. This appears to be an area where we have a more developed peer-to-peer finance network than almost any other country.

The very limited regulatory regime in this area is needed to sustain a diverse and changing range of business models. It would certainly not be appropriate to impose the regulatory infrastructure used in traditional banking here. But, the lack of monitoring means that a single scandal could undermine confidence in the whole market. A subtle and sophisticated approach to monitoring is needed to ensure that the development of this market can be sustained.

O'Brien, L. (2012) "The future of crowd-sourced funding in the UK", The Big Innovation Centre

- 4. Low Carbon Energy** Despite many government and private publications identifying the importance of various markets for the low carbon economy, the Low Carbon Act and repeated statements of intent, confusion persists in this area. In many markets there has been a general failure to translate long term intentions into policy and financial frameworks which can offer the private sector the confidence to invest. This is seen most clearly in the delays over nuclear power. A market making approach to these activities would have prioritised these frameworks.

Levy, C. (2010) "A 2020 Low Carbon Economy", The Work Foundation

- 5. Tele-health** As set out in the previous text box, the integration of digital technologies into healthcare has the potential to change how health services are delivered, increase the effectiveness of treatments and to offer new opportunities for value creation. However, the box above also sets out a leadership role for the public sector in building a market and a network of companies operating in this space in the UK.

The implications from analysis of these potential markets are:

- **Invest in business foresight, not only technology foresight** - Government should not solely focus on future technologies, but also seek to understand the needs and challenges faced by businesses. Focusing on new markets means looking at the business applications of future technologies and ideas, particularly those that meet current or potential economic need.

It is, for example, possible to learn from the creative industries, which appear to be at the forefront of change. Many in this area have been forced to quickly adopt business models which embrace the digital age. These trends, however, are forcing a business model response across our economy.

- **Support markets rather than trying to create them from scratch** - Government should not try to second-guess the private sector. Instead it should focus on supporting entrepreneurs who are experimenting with new technologies and business models, but are facing constraints and challenges around legislation, legal rights, or other policy issues.
- **Look to support changes in consumer behaviour** - The receptiveness of consumers to new ways of accessing services can be critical in the formation of new markets. The public sector can play a major role in ensuring the domestic market is receptive to new products and services.

The tele-health case study above highlights the ways in which strategic public investments and careful procurement can help to change consumer attitudes towards using certain technologies. Demonstration projects, activity to package services and the use of ministers to attract media attention can all help to build confidence around the use of new technologies.

- **Look beyond funding** – While the targeted use of funding is an important element of the market making agenda, many of the most important tools available to the state are broadly cost-free. The state as a legislator, regulator, a convener and an enforcement agent can be tuned to support the formation of new markets.

The potential market for self-driving cars is a good example in this context. Ensuring our regulations can be sufficiently subtle to allow the development of this new technology could determine whether we are a location where the next stages of research and development can be pursued. Clarifying issues over legal liability, for example, could be a cost free way to offer a favourable regulatory environment for this emerging area of activity. Similarly, as set out above, offering enhanced monitoring support for peer-to-peer lending could help to sustain the long term development of this activity in the UK.

- **Work across the whole of government** – This is not an agenda that can be

confined to one department. Unlocking the opportunities associated with 3D printing, for example, will depend on action across multiple departments and agencies.

- **Leadership matters** - Where the public sector has the confidence to invest in and support a new market it should embrace the opportunity. Many investments are likely to fail, either because they choose the wrong areas to focus, or because of implementation failures. However, fear of failure or criticism that investments may be in the wrong area can not result in muddled or confused policy making.

The experience of public policy to support the development of new markets in low carbon areas highlights this risk. There appears to have been only limited success in using the large sums of public funding committed to this agenda to build frameworks which can support private investment in the infrastructures, skills and new business needed to exploit new markets in the low carbon economy.

The government's current approach to industrial policy is split into two parts. There is a focus on supporting individual sectors, and a strand built around investments in eight core technologies. There is a risk here that considering technologies abstracted from their economic context will severely limit our potential to support their development as economic assets, rather than in technical capability terms. The market making approach articulated here offers a way for policy to work across industry groupings, to put in place the conditions needed by new technologies. This will enable us to yield a far greater return on investments in technology development.

## **Delivering public support for innovation in an age of austerity**

The UK has a growth and innovation problem. Half a decade on from the start of the recession, the UK economy continues to flat-line. For a knowledge economy like ours, innovation will be the only source of lasting growth. If we are to recover from recession then the focus of this Spending Review must be on unlocking innovation. This will mean targeted spending to remove the structural issues in our economy and to ensure we can exploit the opportunities presented by new general purpose technologies. If we are to secure a lasting recovery then it is essential that all parties place this innovation-led vision at the centre of their thinking about how to support our economy at the next election.

### **Building policy around support for innovation**

A change in emphasis will be required across the public sector. Economic policy needs to more consistently prioritise support for innovation. Five low-cost policies could help to ensure that we consistently pursue this agenda:

- Encourage all public organisations to set out a clear view of how they fit into the innovation ecosystem. Public sector organisations need to recognise and focus on how they are supporting innovation. This could be achieved by requiring some form of innovation audit to mapping and assess the capabilities and shortcomings. The explicit aim of this assessment must be an on-going consolidation agenda to ensure we can build a stronger set of public institutions, capable of delivering meaningful support for innovation;
- Alongside this stock-take we need tools which can assess the potential impact of policy on our ability to innovate. Above we set out seven ways in which innovation systems fail relating to: investment, infrastructure, internal and external links, institutions, existing public sector activity, capabilities and wider risk factors. Policy and regulatory review processes should be developed to include a consideration of the potential impact on each of these areas of an innovation system;
- The Regional Growth Fund is one of a small number of routes through which the government can deliver targeted investments at scale. As set out above these could be more effective if there was a specific focus on working with LEPs here. In addition the scheme could be developed to favour projects with an innovation focus; and
- The recent announcement that the government will use the SBRI platform to deliver £200m of public procurement is a move in the right direction. This platform is designed to allow a broader range of companies to compete to deliver innovative

solutions to tackle public sector challenges. However this sum represents less than 0.1 per cent of the annual £238bn<sup>98</sup> spend on public procurement. The use of this type of approach to secure innovative outcomes must continue to increase.

## **Delivering the needed programme of investment in innovation**

Given the scale of the structural issues in our economy, significant additional investment will be required. Overcoming these challenges will take time and money, but supporting growth through innovation must be identified as the key priority for public spending by all political parties.

As the 2015 election approaches the importance of this will increase. To offer confidence to potential investors in the UK, and to give our current institutions the space to develop, it is essential that all political parties set out in their manifestos a vision of our economy based on strong and healthy innovation.

In the analysis above we have set out in detail how targeted public action and investment in the infrastructures which underpin innovation could help to unlock growth, including: a broad protection of spending on science, research and technology; investment to bring forward the next generation of digital infrastructures; investment in the platforms needed by big data; action to support Local Enterprise Partnerships as leading local institutions; and further reform of our financial system.

This action needs to be matched by the careful use of an industrial policy and market making agenda to unlock innovation in our economy. The public sector can lead here, to connect organisations, to build confidence in new market areas, and to set frameworks. Done well, sophisticated approaches to industrial policy can drive an economy forwards, sustain and renew areas of strength, and help to open up new market areas for entrepreneurs. However, the UK has limited institutional capacity to act in this way. Our institutional landscape is fragmented. While we have many institutions in this space, most are weak and lack the capacity to lead here. The key department for this agenda, BIS, faces many calls on an increasingly tight set of resources. At a local level, many LEPs are yet to engage with this agenda. The Technology Strategy Board has developed as the leading public agency capable of delivering this type of practical support for innovation.

But this investment cannot wait. We are calling for a £2bn programme of investment in innovation in the 2013 Spending Review. This could boost growth in the short term and help to lay the foundations for a lasting recovery and growing prosperity:

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<sup>98</sup> BIS (2012) "Strengthening UK Supply Chains: Public Procurement "

- In the 2010 Spending Review the science budget was frozen in cash terms. By 2015 this will have represented a real terms 13 per cent cut in funding for our vital research base.<sup>99</sup> Instead, spending here should increase in line with inflation. This will be especially important if the government are to deliver on their commitment to ensure that core funding for science and research keeps pace with our international competitors.

However, this protection is too narrowly set. It makes no sense to protect research, but not research facilities or related technical activities which help us to get the most out of our science base. The focus on the science budget needs to be broadened to a commitment to keep public spending on science, engineering and technology constant in real terms. **This would imply a cash increase of £180m for the area in 2015/16.**

- In addition to this protection, **the government must set aside a further £300m to create the next generation of world class university research facilities.** The rapid development of university-business partnerships under the initial £300m UK Research Partnership Investment Fund has demonstrated a real willingness of businesses to work more closely with universities on capital projects. This is something that must be sustained if we are to continue to fully integrate our academic institutions into our economy. These projects were developed very rapidly and bids were submitted on a short timeline. If the government were to indicate a new round of funding would be available in two years time, there would be greater opportunities for new and perhaps more diverse relationships to form.
- The next generation of broadband connections has the potential to transform our economy. However, international comparisons show that the UK lags much of the world in both the deployment and uptake of this technology. As set out above, a sum of **£100m would be required to ensure that we can catch up on the deployment and uptake of the next generation of broadband connections.**
- Finally, investment is needed to ensure that public policy can deliver a sophisticated approach to industrial policy and to allow our public sector to support market formation around disruptive technologies. While this activity will need to be supported across government, three areas will need additional resources;
  - BIS – in order to ensure that the department can effectively focus on leading this agenda, it must be protected from cuts in real terms. This would require

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<sup>99</sup> This rate is calculated based on GDP deflators forecast by the Office for Budgetary Responsibility published in the March 2013 Fiscal Outlook.

**an additional allocation for BIS of £180m<sup>100</sup>.**

- Regional Growth Fund – has developed as one of only a small number of large scale mechanisms through which central government can deliver effectively targeted investments. **A new £1bn round of investments with a specific innovation focus is needed.**
- TSB – as the only organisation with the capacity to operate as a delivery body for this innovation agenda, the TSB is the natural home for this agenda. However **this developed role will require a major increase in activity and we estimate an increase in budget of 50 per cent, or £220m.**

### **Funding investment in innovation in the 2013 spending review**

It is essential that the 2013 Spending Review finds the resources to prioritise this £2bn investment in innovation. To fund this, the government must choose between a modest delay in austerity measures, the rolling back of expensive and ineffective economic policies and broadening the remit of the current Spending Review.

The success of any fiscal consolidation will depend on economic growth and it is the overall performance of the UK economy which has been increasingly causing concern for international markets. The credit agencies Moody and Fitch cut the UK rating and Standard and Poor's have placed the UK on a negative outlook, both citing the poor growth performance of the UK economy.<sup>101</sup> The IMF has recently cut the growth forecasts of the UK economy for a second time<sup>102</sup>. New analysis from the OECD suggests that the long term growth rate of the UK economy is likely to be significantly below that of the USA and that we have little chance of catching up to their productivity rates.<sup>103</sup> Perhaps most damning of all, the incoming Governor of the Bank of England thinks that the UK is in crisis, recently commenting on impressing US growth figures that that, "The US is breaking out of the pack of crisis countries that includes the euro area, the UK and Japan"<sup>104</sup>.

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<sup>100</sup> This figure excludes the £5.5bn spend of BIS on Science, Engineering and Technology, already counted above.

<sup>101</sup> See for example recent BBC coverage <http://www.bbc.co.uk/news/business-22219382> and <http://www.bbc.co.uk/news/business-20720383>

<sup>102</sup> IMF (2013) "World Economic Outlook Update"  
<http://www.imf.org/external/pubs/ft/weo/2013/update/01/>

<sup>103</sup> Johansson, A. et al. (2013) "Long-Term Growth Scenarios", OECD Economics Department Working Papers, No. 1000. Accessible from [http://www.keepeek.com/Digital-Asset-Management/oecd/economics/long-term-growth-scenarios\\_5k4ddxpr2fmr-en](http://www.keepeek.com/Digital-Asset-Management/oecd/economics/long-term-growth-scenarios_5k4ddxpr2fmr-en)

<sup>104</sup> Elliot, L. (2013) "Mark Carney: UK is a 'crisis country' along with the eurozone and Japan", Guardian: London, <http://www.guardian.co.uk/business/2013/apr/18/bank-england-carney-uk-crisis-country> -

Our analysis suggests that if this investment helped to drive an increase in output of 0.1 per cent it would have paid for itself in increased tax revenues in less than years.<sup>105</sup> There may be a case for delaying austerity measures to tackle these issues which are holding back growth. Given the international perception of the UK economy it seems unlikely that this investment would unsettle the markets.

To date the coalition government have a mixed record on support for innovation. On many occasions, they have demonstrated an ability to support innovation and to tackle these issues in our economy. But despite austerity measures they have introduced a large number of very expensive economic policies which poorly target the structural issues in our economy or innovation and therefore will have little impact on growth.

In the analysis above we have recognised the importance of a more sophisticated approach to industrial policy. A number of investments show this is a serious agenda, such as the £200m Catapult Centre programme, funding for new models of capital partnerships between universities and business, the planned Business Bank and consistent increases in funding for the Technology Strategy Board as an innovation delivery agency. The attempt in the 2011 Research and Innovation Strategy for Growth to present many of these activities as part of a coherent ecosystems approach was also important.

However, the big spending decisions and major investments have too often lost sight of this subtle appreciation of what could unlock growth and innovation in our economy. Cuts in corporation tax, the re-introduction of enterprise zones, increasing capital allowances, the freezing of fuel duty, and small cuts in national insurance contributions are all very expensive policies which reflect an out of date understanding of our economy and are inherently wasteful. For example, the annual cost of the cuts in corporation tax cuts announced in the 2010, 2011, 2012 and 2013 budgets is likely to approach £5bn by 2015/16.<sup>106</sup>

A common feature of all of these policies is that they seek to tweak the costs of doing business in the UK. But, marginal changes in price will have little impact on innovation performance, or the attractiveness of UK companies as global partners for innovation. Innovation is about creating new and different products, services, processes, business models and areas of expertise. These are by definition unique, and therefore not price sensitive.

A second group of expensive policies have nominally targeted innovation. Increases in the R&D tax credit and the introduction of a 50 per cent cut in the rate of tax sound appealing.<sup>107</sup>

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<sup>105</sup> This estimate is based on OBR forecast tax take of 38 per cent of GDP in 2015/16. More detailed academic analysis of the elasticity of various forms of tax income the approximate scale of this effect. Creedy, J. and Gemmell, N. (2011) "The Revenue Elasticity of Taxes in the UK"

<sup>106</sup> Based on Big Innovation Centre analysis of HM Treasury Budget books.

<sup>107</sup> For SMEs the amount of tax deductions possible for qualifying investments in R&D were increased to 225 per cent. For large companies an above the line credit (i.e. a credit applicable regardless of reported profit or loss) was introduced and the rate was increased to 130 per cent.

However, as set out in a recent Big Innovation Centre policy briefing “Will the Patent Box boost the UK innovation ecosystem?”, these measures are expensive<sup>108</sup>, and do little to incentivise companies to invest more in innovation. Evidence suggests that R&D tax credits have little impact on management decisions.<sup>109</sup> The Patent Box is associated with a very significant deadweight cost because it cuts tax on existing patents. Our analysis also suggests that the Patent Box may even distort innovation processes and impede the development of innovative service oriented business models. Measures such as these fail to tackle the structural issues in our economy which are holding back innovation.

Alternatively, if the government are unwilling to unravel these policies or further delay austerity measures then the only option that can support these key investments in growth will be to broaden the terms of the Spending Review. Unlike many areas of economic policy, investments in innovation can boost growth while also being fiscally neutral. These measures do not necessarily require a rolling back of austerity. But the sharpness of spending cuts across many areas of government makes it more difficult to free up public resources to invest.

The 2013 Spending Review is unusual because the government have committed to a specific cut in current and capital budgets for 2015/16, and the protection of spending on the NHS, schools and international assistance. Under this framework the £2bn investment programme will need to be resourced from the unprotected £180bn portion of public spending which can readily be influenced by policy (termed the Departmental Expenditure Limits). The implication is that finding £2bn in this environment would require a 1.1 per cent cut across other un-protected areas.<sup>110</sup> The current reluctance to consider cuts in portions of these budgets increases the scale of the challenge.

Redirecting resources towards the priorities set out in this Submission has to be part of a bigger discussion on tax and spending which is beyond the scope of this report. However, the recent IFS Green Budget points out that significant sums could be raised by taking a more consistent approach to welfare benefits and by increased taxation of the well-off. For example, extending means-testing to some pensioner benefits such as the winter fuel allowance and TV licences could raise between £1.5 billion and £2 billion in 2015-2016, while increasing council tax bands for the more expensive housing could generate another £2 billion. The IFS gives several examples of other tax changes that would disproportionately impact on the well-off, which are less easy to estimate but would offer significant tax revenue gains. With so many claims on the extra resources a future government could potentially raise, it would be unrealistic to argue that all of the proceeds should be spent on supporting innovation. However, it is plausible to advocate that a significant share should to be devoted to initiatives and projects which underpin longer run

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<sup>108</sup> HM Revenue and Customs estimates suggest that by 2015/16 the patent box will cost £820m each year in foregone tax receipts. HM Revenue and Customs (2011) “Corporation Tax Reform: Patent Box”

<sup>109</sup> HM Treasury (2011) “An Evaluation of Research and Development Tax Credits”

<sup>110</sup> Big Innovation Centre calculations based on Institute for Fiscal Studies analysis accessible here: <http://www.ifs.org.uk/projects/2/418>

growth.

Half a decade on from the onset of the credit crisis the UK economy is still failing to consistently deliver growth. An innovation led recovery is the only plausible route to sustained prosperity. Public policy must now remorselessly focus on removing the structural issues in our economy which are holding us back and on unlocking the opportunities presented by new disruptive technologies.

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