

Levelling up the UK's regional economies

Increasing the UK's rate of economic growth

Lord Sainsbury of Turville
March 2021



About Centre for Cities

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Introduction and summary

There are major regional inequalities in the UK today and the Government has committed itself to levelling up the wealth of the poorer regions. But it should not be thought that this will be easy to do as regional policy in the UK in the last 90 years has achieved very little. Nor will the spending of large sums of money on projects in the poorer regions increase their wealth long-term if it is not targeted on creating more innovative, high value-added per capita jobs and firms in those regions.

The main reason why regional policy in the past has been ineffective is that we have not had in the UK a regional level of government that could provide the necessary leadership for regional regeneration. The development, however, of Mayoral Combined Authorities (MCAs) in recent years now provides the Government with an opportunity to develop a new effective set of regional economic development policies that would level up the poorer economic regions, and contribute to increasing the UK's rate of economic growth.

In view of the Government's commitment to levelling up the regions of the country, and the fact that the Centre for Cities has done a large amount of work on the economy of cities, I thought it would be valuable to put together their research with some relevant research done by the Centre for Science, Technology and Innovation at Cambridge University, to produce an effective policy document. This I have done in the following pages, and I would like to thank the Centre for Cities for all the help they have given in the preparation of this document.

The basic premise of this document is that the best way, based on the experience of other countries, to increase the wealth of poorer regions is to support the growth of existing or potential clusters of high value-added businesses in them. These can be either manufacturing or service businesses, but they must be ones that have a competitive advantage in global markets. And the support must be co-ordinated by regional bodies such as the MCAs and not by the central government.

If, however, MCAs are going to be able to co-ordinate the support for high value-added clusters within their boundaries, two important organisational changes need to be made, and also some of the Government's R&D budget needs to be allocated on a regional basis.

The first of the organisational changes is to give the Mayors of combined authorities the clear responsibility for spatial planning and transport policy in their cities. This would bring them in line with the organisation of the Greater London Authority, and would involve moving some spatial powers up from local authorities that make up the MCAs, and moving some transport powers down from Whitehall.

This would be a significant change, but bringing together spatial planning and transport planning together at the Mayoral level would seem to be a very obvious way both to improve the management of our cities, and to create a favourable environment for all businesses within them.

The second change would be to give MCAs the power to align the courses run by further education (FE) colleges within their boundaries with the needs of industry. At the current time, the way that FE colleges are funded means that, in order to survive financially, many must spend a great deal of time competing to attract students to those courses that are cheap to run. By giving the MCAs the authority to co-ordinate the courses put on by FE colleges, and by incentivising collaboration between colleges rather than competition, this could be stopped, and the courses delivered could be brought in line with the needs of industry.

Finally, for mainly historical reasons the R&D spending of the Government is heavily concentrated on centres of excellence in the South of the country, and if the growth of high value-added businesses in the poorer regions is to be encouraged, a proportion of it should be targeted at the poorer regions. This should not be difficult to do as it can be achieved by strengthening and altering the recently introduced Strength in Places Fund.

As well as giving more powers to the MCAs, it will also be necessary for the Government to co-ordinate its own actions more effectively, and make one government department, the Department for Business, Energy and Industrial Strategy, the lead department for levelling up. It is also suggested that a National Council for Innovation is set up to see that the regional economic growth programme is closely connected with the other work of government on economic growth.

These changes would be extremely significant ones and would enable the Mayors to play a much more important role in growing the wealth of their cities, while enabling the Government to maintain overall control over the nation's policies and finances.

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The problem of regional inequality

There are very substantial regional differences in economic performance in the UK

At the extremes, London's output is 2.5 times that of the North East of England. And while London is exceptional, the differences between the remaining regions are still significant (up to 50 per cent) as shown in Figure 1.

Figure 1: There are significant differences in economic performance across the country Regional GVA per head of resident population, 2018 (£000s)



Source: ONS, Regional Gross Added Value (GVA) at current market values, 2018, and Business Register Employment Survey, 2018 data.

To illustrate the extent of these differences, the output per head of the South East during the first lockdown of the pandemic is similar to that of Wales in normal times (assuming the impact of the first lockdown at 35 per cent).¹

On top of that, recent research by Centre for Cities revealed that the economic impact of the pandemic is now making the task of levelling up these inequalities even more challenging.²

The economic underperformance of the UK's cities is the single biggest barrier to levelling up

Some of the differences in economic performance across the country stem from the different roles different places play in the national economy. The ability of different parts of the country to create and attract high-value firms and jobs, and hence drive productivity, varies between urban and rural areas, with urban areas best placed to do so. Expecting the South West – a predominantly rural region – to perform in the same way as the Greater London urban area does, is simply unrealistic.

However, what should be expected is urban areas across the country to perform similarly. Yet, in practice, productivity per worker in Reading is 60 per cent higher than in Doncaster, the average weekly workplace wage in Cambridge is 40 per cent higher than the average weekly wage in Burnley and the employment rate of Oxford is 20 per cent higher than that of Blackburn.

Whilst many of the urban areas that are currently underperforming are in the North and Midlands, the divide is not simply due to geography, nor is it the case that all cities in the North are struggling.

This point can be illustrated by looking at two cities: Bradford and Leeds, which while they are only eight miles apart, look very different economically. Leeds has a larger share of population of working age, and people in Leeds are more likely to have more qualifications – only 6.7 per cent of its population has no qualifications, half the share in Bradford. The population in Leeds is also more likely to be in employment, Bradford's employment rate is eight percentage points lower than in Leeds. People in Leeds also have higher wages, with average weekly earnings of £561 compared to £538 in Bradford.

These differences reflect differences in productivity between the two cities, GDP per worker in Leeds (£60,300) is 13 per cent higher than in Bradford (£53,600), and much of this gap in productivity can be explained by the differences in the type of industry in the two places. In Leeds 17 per cent of the jobs are in high-skilled exporting businesses, such as finance and insurance, professional services and information and communication. And these account for 24 per cent of all output. In Bradford only 10 per cent of the jobs are in high-skilled exporting businesses.

These differences in industrial structures between Leeds and Bradford have not always been there. Up until the mid-1950s, the composition of jobs in both places was fairly similar with Leeds having marginally more jobs in services exports and Bradford having a larger share of jobs in goods exporting sectors. During the 1950s an important divide opened up as the share of service exporting jobs began increasing much more rapidly in Leeds than Bradford.

The example of Leeds and Bradford demonstrates that the regional inequalities we see are not simply due to geography but to the ability of cities in different parts of the country to respond to economic change and reinvent themselves.

If the country's underperforming cities closed their output gap, the UK's economy would be £69.9 billion larger.³ And, in particular it is the underperformance of the largest cities after London that is the biggest barrier to achieving the levelling up ambition. The eight largest cities after the capital account for 70 per cent of the above-mentioned output gap. Improving their economic performance to be in line with European counterparts would be equivalent to adding two extra economies the size of Newcastle to the national output.³

Policy decisions over the past century have not helped cities adapt and grow

Over the past few decades, the UK has shifted towards a high-value added economy, but, as previous research by Centre for Cities highlighted, not every city has been able to adapt to this change.⁵ The high-value service and manufacturing businesses that drive productivity and economic growth prefer to locate where they can have access to shared infrastructure, a large pool of high-skilled workers and similar businesses with which to share ideas and innovate. But while cities are on average better placed than rural areas to offer these benefits, there has been significant variation in cities' ability to attract these businesses. Those who have been able to attract these businesses, such as Leeds, have adapted and reinvented themselves, gradually becoming more economically successful, while other places, like Bradford, which have struggled to do so, have attracted fewer high-value businesses and hence have a weaker economic performance.

Also, the majority of policy interventions aimed at helping places to grow have tended to reinforce the existing industrial structure of different places by supporting low-knowledge routine activities to reduce unemployment, as opposed to supporting the reinvention of cities by increasing their attractiveness to more knowledge-intensive businesses. As a result, in many cities in the North, jobs in declining manufacturing and production industries have been replaced by low-skilled routine jobs which are vulnerable to foreign competition and technological change, with call centres and distribution sheds replacing cotton mills and dockyards.

And in more recent years, in order to improve the economic performance of regions, places have been encouraged to develop 'industrial strategies'. But this policy has also not proved successful in raising the level of regional economic growth as many regional

bodies have neither had the skills to assess the global competitive strength of firms in different sectors in their areas, nor the resources to support firms in different sectors.

On top of that, national policies aimed at promoting innovation over the past 50 years have been skewed towards particular places. Resources and investment around research and innovation have not been spread evenly across the country but concentrated in the Greater South East. Currently, just three sub-regions of the UK – Oxford and its environs, Cambridge and its sub-region, and inner West London – account for 31 per cent of all R&D spending in the UK. Public sector R&D is even more concentrated with 41 per cent taking place in these regions.⁶

These factors combined mean the South has been pulling away from the North for a century, and since 1911 for every job created in the North, Midlands and Wales 2.3 have been created in the South.⁵

This has obvious implications for policy-making. It means that we will only be able to level up the underperforming regional economies by creating more high value-added, knowledge-intensive firms and jobs in their largest urban areas. And this will mean finding a way to get more R&D done in them.

It is also interesting to note that the US is facing a similar problem to the UK. In the last 40 years, the innovation sector in the US, comprised of the nation's highest-tech, highest R&D, advanced industries, which contribute inordinately to prosperity, has become concentrated in a short list of superstar metropolitan areas.

Just five top innovation metro areas – Boston, San Francisco, San Jose, Seattle and San Diego accounted for more than 90 per cent of the nation's innovation-sector growth during the years 2005 to 2017. As a result, politicians and policy analysts in the US are also looking at how they can direct more R & D funds to older industrial areas in order to level them up economically.

02

A strategy to level up regional economic growth

To 'level up', economically weaker performing cities need to become clusters of high-value activities

As outlined in the previous section, government policies that have explicitly attempted to reduce the North-South divide, which can be traced back to the 1930s, have not been effective. We have had 90 years of policies attempting to boost growth in the regions, but the gap in performance has widened over this period.

A better strategy to reduce regional inequalities across the country consists in supporting places to develop clusters of high-value activity. Clusters have been described by Michael Porter of the Harvard Business School as 'geographic concentrations of interconnected companies, specialised suppliers, service providers, firms in related industries, and associated institutions (for example, universities, standard agencies, and trade associations) in particular fields that compete but also co-operate'. They are important because they enable firms in the cluster to gain competitive advantage.⁸

These clusters tend to be predominantly urban in nature, and there are good economic reasons for it. Urban areas offer three economic benefits known as 'agglomeration benefits' that enhance their performance as clusters. These are 'thick' labour markets, the presence of specialised service providers, and knowledge spillovers.⁹ The more vibrant their labour market is – the 'thicker' it is – the more likely they are to attract high-value, knowledge-intensive businesses that drive economic growth, with benefits for the wider region too.

The UK's industrial history has many examples of the existence of clusters enhancing the growth rates of city regions: cotton textiles in Manchester, steel and cutlery in Sheffield and pottery in Stoke-on-Trent.

Clusters also play a significant role in the UK's economy today. According to research by McKinsey and Centre for Cities there are 31 clusters across the country, including the 'Golden Triangle' – the pharmaceutical and biotechnology cluster with its hubs in Cambridge, Oxford and London, the financial services cluster in London and the aerospace clusters in the North West and South West. It also includes lesser-known clusters such as 'Motorsport Valley', the area surrounding the Silverstone circuit in Northamptonshire. Home to a concentration of Formula 1 motor racing teams and thousands of specialist motorsport suppliers, in 2012 it generated revenue of £9 billion and employed 41,000 people, including much high-performance engineering talent.

Overall, these 31 clusters contain 8 per cent of the UK's businesses, employ four million people, one in seven of the working population, generate 20 per cent of the UK's output (gross value-added) and offer average salaries that are typically higher than those in the surrounding region.¹⁰

There need to be the right conditions locally for clusters to be successful

By identifying current strengths and weaknesses of UK's clusters, the McKinsey and Centre for Cities research outlines three sets of recommendations that can help places maximise the economic potential of their existing and emerging clusters:

- 1. Better integration between high-value businesses and other innovation-generating activity at the local level.** Currently, many of the UK's cities are not fulfilling the potential of their clusters to foster innovation, and have been less successful than some of their global peers in tapping into local sources of innovation, whether it is with other firms or universities. To maximise their potential, universities need to strengthen their contribution to their local businesses, and additional actions should be taken at a cluster level to promote idea sharing, especially by increasing interaction between businesses and academia, and by providing specialist facilities to support the interactive refinement of innovations.
- 2. For clusters to be successful, businesses must be able to access the skills they need.** Education and skills systems are not producing the concentration of specialist skills that clusters need, and education and skills providers should work directly with cluster employers to offer courses that equip the right number of people with the skills in demand.
- 3. Clusters need to be supported by the right infrastructure.** Every cluster examined in detail by Centre for Cities and McKinsey had specific infrastructure challenges holding back growth, whether they were transport (road, rail or air links), or broadband, housing or energy. Addressing these infrastructure challenges would boost economic activity in the clusters.

While clusters are generated by market forces, international evidence suggests national governments can play a role in enhancing their growth

A key question for policy-makers is, of course, why clusters emerge in specific areas. The answer is that clusters emerge in a specific area because of a capability/market opportunity dynamic. Innovative clusters take off in a particular place because a market opportunity is created by a technology becoming available to fulfil a latent or well-known demand, and firms exist or are created that have the capability to take advantage of it.

This explanation of clusters in the making is valid for Silicon Valley in the 1950s and 1960s but also for other more recent, well-established clusters in the United States, such as North Carolina, San Diego and Seattle, as well as those in places outside the US, such as Cambridge (England), Taiwan and Israel.

In the case of all these clusters, they took advantage of a market opportunity created by new technology. In the Silicon Valley of the 1960s, in the other United States innovation clusters, and in Cambridge, it was the integrated circuit industry; in Israel it was the internet and network-security markets; while in Scandinavia and Taiwan it was the hardware and equipment opportunities in new kinds of devices, such as cell phones and personal digital assistants.

This is an important point for policy-makers to understand because clusters emerge when entrepreneurs see that an opportunity exists and create firms that have the capability to take advantage of it. There is very little that governments can or should do to assist this process because governments do not have the detailed knowledge of market opportunities or firm capabilities to make such judgements.

But once the growth of a cluster is underway, policy-makers can help by allocating and co-ordinating R&D, education and training, and infrastructure resources to support it.

If we look at the history of many US technology hubs, for example, it is clear that the Federal Government played an important, if not decisive, role in providing them with the resources to become innovation stars. For example, in the period before the Second World War many people believed that Boston would go the same way as the rest of New England, with the city's traditional manufacturing of textiles, shoes and machines migrating to the low-cost South and decline setting in.

But Boston became one of the leading innovation hubs in the US as the Second World War brought substantial amounts of federal funds into the city, especially for the development of military electronics. This support was dramatically increased at the start of the Cold War with, for example, the MIT Lincoln Laboratory, a Defense Department research and development centre, being established in 1951, and becoming a hub for electronics research nationally.

The development of Silicon Valley also benefited from federal funding, with the establishment of the Lawrence Berkeley National Laboratory in 1931, and what became NASA's Ames Research Center being set up in 1939. Stanford University and the University of California, Berkeley received significant funding in the post-war era, and massive amounts of defence funding for R&D and prime contractors followed into firms in the area.

Similarly, while Austin in Texas was home to many technology companies before the arrival of Sematech, the decision of Sematech, a consortium of semiconductor firms in part funded by the Defense Advanced Research Projects Agency, to locate their headquarters there in 1998 helped cement the city's technological leadership position.

And this is not unique to the US experience. Across the world, in other successful economies, governments have also taken action, though in different ways, to support the growth of clusters in cities (see Appendix 1 for more details on some of these examples, such as the Hsinchu Science Park in Taiwan, Canada's Innovation Superclusters, Biopolis in Singapore, and China's science parks).

As a result of the accumulating evidence of the impact that high-tech clusters can have on the growth and prosperity of cities and regions, policies are increasingly being put forward for governments to support the growth of clusters in their regions.

In a recent report, the Brookings Institution and the Information Technology and Innovation Foundation emphasised the importance of strong metro areas as catalysts for economic growth. To counter regional economic divergence, it called for the US Government to designate eight to 10 'Growth Centers' outside established innovation hubs across the heartland of the country but in metro areas with substantial innovative capacity. They called for the Federal Government to focus transformative investment on these places in order to catalyse their economic take-off.

The report argued that the high level of regional inequality in the US today is a grave national problem. In economic terms, the costs of excessive innovation concentration are creating serious negative externalities. These range from spiralling home prices and traffic gridlock in the superstar hubs to the undesirable 'sorting' of workers, with college-educated workers clustering in these few superstar cities, leaving other metro areas to depend on thinner talent reservoirs. As a result, whole areas of the nation are now falling into 'traps' of underdevelopment.¹¹

A similar situation can be observed in the UK with a concentration of R&D spending and innovation in the Greater South East. Places like Oxford, Cambridge and London are also facing the costs of excessive concentration of innovation and economic activity with challenges around affordable housing, traffic congestion and air pollution.

Conducting a similar analysis on the UK, Centre for Cities identified those metro areas outside the Greater South East which have the potential to become growth centres and to foster regional growth. These include, for example, cities such as Coventry, Newcastle and Leeds.¹²

Moreover, in *Jump-starting America*, published in 2019, two American academics at MIT, Jonathan Gruber, the Ford Professor of Economics and Simon Johnson, the Ronald A Kurtz Professor of Entrepreneurship, proposed that the US Government should devote an additional half of one percentage point of GDP to research funding – roughly \$100 billion per year. They proposed the money should be spent on creating new technology hubs away from the current superstar cities, and that the cities should be chosen by a ‘catalyst competition’.¹³

To capture the benefits of agglomeration they also argued that the dollars must not be spread too thinly. Places must create a compelling case for skilled workers, researchers and investors to locate there. This means picking winners and not simply succumbing to political pressure to give money to any qualified city.

It would appear that their argument has been well received, and a bipartisan, bicameral ‘Endless Frontier Act’ has been proposed in the US. The Endless Frontier Act proposes an expansion of the National Science Foundation – to be renamed the National Science and Technology Foundation (NTSF) – and the establishment of a Technology Directorate within NTSF to advance technology in 10 critical focus areas.

The newly-established Technology Directorate would receive \$100 billion over five years to lead investment and research in artificial intelligence and machine learning, high-performance computing, robotics, automation, and advanced manufacturing. But perhaps most interestingly of all, an additional \$10 billion would be authorised to designate at least 10 regional technology hubs, awarding funds for comprehensive investment initiatives that position regions across the country to be global centres for the research, development and manufacturing of key technologies.

Summary

The evidence from around the world suggests that supporting high-tech, high value-added clusters in poorer regions is the best way to reduce regional inequalities, and an effective way to improve the growth rate of the country. But to do so in the UK will not be easy, and will require the achievement of two objectives:

- 1. It will be necessary to develop robust institutions to which powers can be devolved** that will enable the devolved authorities to assist (a) their current companies to upgrade and (b) new high value-added per capita ones to be created. Neither of these tasks are ones that can be orchestrated by politicians and civil servants in Whitehall.
- 2. It will be necessary for the Government to allocate resources in areas such as R&D, skills and transport, to the devolved authorities** to enable them to co-ordinate them in such a way as to provide locally the environment that supports the growth of high value-added per capita firms and jobs.

These will be the two topics of the next two sections.

03

The development of Mayoral Combined Authorities

To support the growth of clusters, the UK's local government structure must change

There are very substantial regional inequalities in the UK, but equally the development of Mayoral Combined Authorities (MCAs) in recent years means that a huge opportunity exists to tackle these regional inequalities. This is because the Government could now devolve to the MCAs as democratically accountable bodies the powers and resources they need to provide the conditions for regeneration and the growth of high value-added per capita jobs within them.

In the past, many attempts at regional regeneration in England have failed because there were no effective regional bodies to which economic development could be devolved. This was a major problem because the tailoring of policies to regional conditions and the co-ordination of different policy areas at a regional level are essential features of economic regeneration and cannot be done by politicians and civil servants sitting in Whitehall. The development of MCAs in recent years means, however, that the key powers and resources necessary for economic regeneration can now be devolved to them.

Decentralisation, particularly devolution to large urban areas, has been a key policy feature of the past 50 years in many developed countries. Over two-thirds of metropolitan areas in the OECD now have established local institutions aimed at promoting their metropolitan-wide development. These arrangements vary in nature from informal collaborations to more formal bodies, but they share similar responsibilities. The vast majority (80 per cent) focus on regional development, 70 per cent focus on transport and 60 per cent have responsibilities over spatial planning within the metropolitan area.¹⁴

Also, the evidence suggests that, where there is metropolitan-wide governance, it leads to a number of desirable outcomes such as lower urban sprawl, higher satisfaction with public transport and lower levels of air pollution. Decentralisation can also enhance local growth.

Designing and delivering effective regional policies, however, can only be done if there are effective and efficient institutions at the regional level which share three features.

- 1. They should match the geography of the local economy.** Designing local institutions in a way that reflects the geography of people's lives in terms of work, travel, and education and training, enables policy-makers to co-ordinate their activities in these areas and make them more effective.
- 2. They should have accountable leadership.** Having directly elected leaders helps reconnect people with institutions, raises the profile of a regional area on the national stage, and offers accountability for the decisions taken by such bodies.
- 3. They should have adequate powers and resources to help create the high value-added per capita jobs and clusters that are needed.** To be effective, local bodies must have control of the decisions best taken at the local level, and have adequate financial resources to do what is needed.

The three features outlined above provide an explanation of why existing bodies such as Local Enterprise Partnerships (LEPs) have had limited success in promoting regional economic growth to date. They often do not cover a meaningful economic area, they have limited powers and resources, and lack political leadership and accountability.

In contrast MCAs with directly elected metro mayors, despite only being operational since 2017, are increasingly showing they are the way forward for the UK.

All city regions should become MCAs

As a key step in levelling up economic performance of the regions, the Government should extend the MCA model to all existing combined authorities.

Currently, there are two combined authorities without metro mayors: the West Yorkshire Combined Authority, which is to become an MCA with its first elections in May this year, and the North East Combined Authority. Political tensions at the local level have meant that constituent authorities in support of a metro mayor formed the North of Tyne MCA, while the North East Combined Authority, without a metro mayor, now has limited powers to bring about change in its larger area. The split divides the regional economy into two, creating an artificial barrier in policy around Greater Newcastle.

On top of that, the Government should complete the process of devolution by creating MCAs in all the city regions that do not have one but could benefit from the change. MCAs are proving a success, and the Government should no longer wait for places to come

forward to form MCAs. The Government should also work on the assumption that every city region should become an MCA, setting this out as an expectation to kick start negotiations, and giving clear incentives to local areas to become MCAs. Similarly, the devolved nations should press ahead with creating Greater Cardiff, Glasgow and Belfast MCAs.

For areas outside city regions, the current two-tier local government system should be replaced by a single-tier system

Alongside MCAs, other parts of the country too should benefit from local government reorganisation and devolution.

As highlighted in previous research by Centre for Cities, this could take the form of a single-tier system. In a single-tier system, in which all county-district structures are replaced by a unitary authority led by a directly elected mayor, powers over spatial planning, transport and skills that are currently split between the two tiers would be joined up, and this would help support economic growth at the local level.¹⁵

Other existing local growth bodies should be integrated into the new system

Finally, for this reorganisation to have the biggest impact, the Government needs to align the boundaries of the LEPs with those of the new system of MCAs and single-tier authorities, and then integrate the LEPs within these authorities.

LEPs and MCAs are too similar in their intended purposes to either co-exist as joint leaders of local economic strategies or to cover different geographies.

In most places where MCAs have been created, this problem has been avoided. Existing LEPs have voluntarily integrated into MCAs, recognising that the clear democratic mandate of mayoral elections supersedes the more limited public accountability of the LEP.

It is, therefore, suggested that where LEPs have not been integrated into MCAs, they are replaced by a single Industry and Skills Board to advise the Mayor, and that this becomes the standard model for MCAs and other single-tier authorities.

04

The allocation of powers and resources to MCAs

If MCAs are to have a positive impact on local economic growth they need to have the necessary powers and resources in the three areas of transport and planning, skills and R&D.

The role of MCAs is then to co-ordinate activity within these policy areas, allocating resources according to their local needs and linking up different initiatives to maximise their potential in driving local economic growth.

1. Promoting local economic growth by joining up transport and spatial planning

Transport, together with spatial planning, has an important role in driving development within a city region. Local transport systems are crucial to the performance of local economies because they carry the majority of journeys people make to work, education and leisure every day. Commuting is a cost, in money and time, that workers must trade off against the higher wages and housing availability at either end of the journey.

An efficient transport system that makes journeys quicker and more affordable reduces this cost and generates two major benefits. First, it widens labour markets by putting more people within an acceptable commuting time, allowing efficient matching of people and jobs, and greater specialisation and complexity in local economies.

Second, an efficient transport system enables employment and business to cluster densely where they have the best access to knowledge, such as in city centres. More efficient transport systems mean that investments to level up innovation across the country can be focused even more tightly to where they can have the greatest potential impact, which is in city centres. More firms can cluster into local areas of excellence, while a wider pool of residents from further afield can access the higher wages and employment in these areas.

Local transport systems in MCAs can be made more efficient both by making better use of the existing infrastructure, services and funding, and by planning policy and economic regeneration plans. In the first case, raising the cost of driving and cutting bus fares reduces congestion and increases the passenger capacity of the road network, while making journeys for the majority of commuters affected faster and more reliable.

Focusing on slower but more frequent stopping services on rail services, or reducing rail freight paths during the working day, can allow many more people to use trains. Removing competition between modes, such as trams and buses, frees up capacity to be deployed elsewhere. Making ticketing, fares and timetables simpler across different modes can also make it easier for people to make connections across bus and tram, for example.

Transport systems can also be made more efficient by non-transport policy. Planning policy and economic regeneration plans affect where people live and work and thereby travel. Building thousands more homes in city centres allows more people to be able to walk and cycle to work.

But transport systems in England's biggest cities outside of London are not taking advantage of such opportunities and are significantly underperforming. The city centres of cities such as Leeds, Birmingham and Manchester have relatively poor public transport accessibility. These cities also have the greatest potential outside the Greater South East to increase their rate of innovation and increase their value-added growth. But their current transport systems mean that there will be heavy costs of higher growth in these city centres. London's public transport system carries nearly 20 times the passengers of each of these cities into the city centre. It also carries them more quickly on average.¹⁶

Cities in the UK today have little control over the infrastructure, services and funding for public transport. In Manchester, only around one-third of peak time public transport journeys into the city centre, and in Birmingham less than one in 10 commutes, are directly influenced by their transport authorities through their control of the light rail system. In Leeds, no public transport journeys or revenues are controlled by the city region. Cities reliant on public transport are reliant on regional franchises and local subsidiaries of national bus companies to keep their labour markets working.

To unlock significant improvements to city region transport systems and local economies over the next decade, MCAs need the following three changes to be made:

i) Spatial planning powers

Government must move statutory spatial planning authority from local authorities to metro mayors. Areas with underused or improved transport services should match that with significant intensification of development. This will improve the efficiency of the transport system, and generate higher fare revenues to invest elsewhere. All metro mayors should have the same powers to create a statutory spatial plan to which local authorities must conform, as the Mayor of London has.

ii) Funding and franchising bus services to London levels

The cost to Greater Manchester to taking up the powers given to it in the Bus Services Act 2017 is £134 million to purchase the bus depots and vehicles it considers important to foster a competitive bus franchising system.¹⁷ This provides a significant practical obstacle to cities considering taking up these powers, and one that London did not face when it moved from a publicly owned bus system to a franchised model. The creation of bus franchising will immediately support the institutional capacity of city region transport bodies. The Government's £5 billion bus, walking and cycling fund (£2 billion was recently committed to walking and cycling) should include £1 billion for metro mayors to take up bus franchising quickly.

iii) Control over rail services

MCAs have been given greater say over franchises such as Northern and West Midlands Rail. These are now the single most important mode into every major city centre, and too important to be run between the Department for Transport, regional franchisees and MCAs with divergent interests and incentives.

Government should devolve responsibility for these services and stations to the metro mayors so that they can control services and development around them to increase efficiency and maximise the contribution to the local economy.

2. A skills system better aligned with business needs

The development of a national system of qualifications covering both apprenticeships taught mainly in firms, T-levels and higher technical qualifications taught mainly in further education (FE) colleges provides an opportunity for better co-ordinating at a city level the courses run by FE colleges with the labour market needs of the city. Educational policy should, however, continue to be set at the national level.

The income of FE colleges comes from a range of sources, including apprenticeship funding, learner loans and commercial income. The two largest components however are: the adult education budget (AEB), which is ringfenced for the training of specific groups of adults, often those with low prior educational attainment; and grant funding to pay the costs of courses taken by 16-to-19-year-olds. Since August 2019, the AEB has been devolved to MCAs where they exist, accounting for around half of the £1.3bn AEB total spend in England each year.

The 16-19 budget for England totals around £5.6 billion a year. Around £2.9 billion of this goes to schools and sixth-form colleges and the remainder (around £2.6 billion) goes to FE colleges. The 16-19 budget is not devolved. Instead it is allocated annually to individual schools and colleges by the Education and Skills Funding Agency (ESFA) based on the courses delivered and the characteristics of the learners (e.g. their level of disadvantage).

Neither the AEB nor 16-19 funding has robust requirements attached for the money to be spent on courses that meet labour market needs. Colleges consider a number of factors when selecting what courses to offer. While the best colleges will consider local labour market need, few do this well, and learner choice and funding rates tend to be far more influential factors, not least because colleges must offer provision that, at least collectively, is financially viable in the long term.

It is thus wholly unsurprising that a mismatch often arises between the skills the labour market needs and those being supplied by colleges and other training providers. This mismatch is magnified by the fact that individual colleges (and schools, sixth-form colleges and independent training providers) in a local area are not required to work together to plan a coherent training offer. Instead, they compete with one another to attract learners, especially onto the courses with the highest margins (i.e. those that are popular and cheap to deliver). Where a college feels that there is a risk of a competitor stealing its market share of a low-volume, high-cost course (especially one requiring significant upfront capital investment), or that the margins from a specific course are just too tight, it may well not offer the course at all, regardless of its value to the local labour market.

Not only is this mismatch of skills supply and demand a drag on our economy's productivity – with businesses unable to recruit employees with the skills they need – it is also a drag on social mobility, with many people finding themselves leaving education with qualifications that have little currency in the local jobs market. The current unco-ordinated approach to publicly funded training provision has demonstrably failed, with billions of pounds misdirected towards low-value training at the expense of the skills our economy needs. This has to change.

(i) Skills provision must be commissioned based on labour market needs.

But articulating local labour market need cannot be done at the national level: Whitehall is ill-equipped to understand the specific needs of, say, the manufacturing sector in the North East. Local skills plans must be based both on rigorous data, including, for example, demographics, job vacancy numbers and travel-to-work times, and the input of local employers, which crucially must include small- and medium-sized enterprises. Colleges and other training providers need to be brought into this conversation from an early stage too, not least because they often will have useful intelligence about why skills gaps have grown over time.

Once a clear articulation of skills need has been arrived at, a plan for delivering it must be developed. A large city region might have a dozen colleges and many more independent training providers in receipt of public funding for skills. We must move away from the current system of competition between these providers towards one of collaboration across a local area to deliver an agreed plan. This will sometimes require tough decisions: for example, perhaps deciding that capital-intensive provision would be better concentrated in a smaller number of colleges, resulting in some having to close their engineering departments.

Local skills plans should take account of all training paid for from the AEB and 16-19 grant funding. It should be noted that this includes the 16-19 provision in secondary schools and sixth-form colleges, and it is important that these institutions are included if any planning for an area is to be coherent. We must avoid a situation where FE colleges are restricted to only those courses that align with labour market need, while schools and sixth-form colleges are permitted to offer any popular courses they wish, as this would quickly see these institutions becoming over-subscribed with 16-year-olds wishing to study, for instance, sport science or performing arts, creating even greater pressure on the viability of FE colleges. Additional government investment of capital funding for skills provision (of the type announced at the 2020 Budget: £1.5 billion to refurbish college buildings) should also be dispersed in line with local skills plans.

(ii) MCAs should be in charge of local skills plans.

A move to this type of commissioning model will require strong vision and leadership at the local level. In a welcome move, the FE White Paper published at the end of January, acknowledges the importance of these actions and co-ordination at the local level.¹⁸ But, while the FE White Paper suggests these responsibilities should fall within the remit of the local chambers of commerce, it is the MCAs that are best placed to take on this leadership role for their areas and it is they who should be charged with the production of local skills plans. In areas not covered by MCAs, alternative arrangements for the development of local skills plans will need to be implemented. While further work is required to establish whether a single solution can meet the needs of all non-MCA areas, the starting assumption should be that LEPs – either individually or in collaboration with neighbours (in order to achieve an appropriate geography for coherent planning) – should be strengthened such that they are able to undertake the role envisaged here for MCAs and develop local skills plans.

Outputs from the newly established skills advisory panels (SAPs) and the recently announced Skills and Productivity Board (SPB) – charged with producing labour market analyses at the LEP and national level respectively – will be important inputs to each MCA's deliberations. As too, of course, will be the views of local industry.

AEB funding has been devolved to MCAs only since August 2019 and it is too soon to judge how well MCAs are managing this (approximately £650 million a year) budget to meet local needs for adult skills training. Devolution of spending decisions relating to the much larger 16-19 education budget needs to be implemented in a measured way. The Government needs to have confidence that MCAs have the capacity and expertise to undertake the far-from-trivial tasks of analysing labour market need and employer demand; matching this to appropriate training provision; and negotiating with training providers to reshape their offer while still maintaining continuous, quality provision.

In the short term, while the new system is bedding in, local skills plans created by MCAs should be submitted for approval centrally by the Department for Education. However, this should be done on the understanding that in the medium term – say three years – there is an expectation that MCAs will have autonomy to enact their skills plans without requiring formal sign-off by Whitehall. While the number and mix of courses offered locally would then be at the discretion of the MCA, the overall skills budget for each MCA would still be set centrally. To avoid unnecessary duplication of bureaucracy, funding receivable by individual training providers – set in the local skills plan – would still flow directly from the ESFA, as is the case now. There is no compelling argument for devolving *administration* of 16-19 funding to local bodies such as MCAs. National regulations around, for example, which courses are of sufficient quality to attract public funding, and arrangements for Ofsted inspections etc., would also still apply.

3. More resources for R&D

As we have seen, if regions are to produce higher levels of GVA per capita they need to have an economic base composed of firms that constantly innovate and create competitive advantage in global markets. And to create such a base a technology-based growth strategy needs to integrate into an efficient innovation ecosystem, public and private research, technology development, and organisations such as incubators and accelerators that can assist with commercialisation.

(i) Improving the Strength in Places Fund

In the UK there is also a need to allocate the Government's support for R&D more evenly across the country if the country is to improve its rate of economic growth. In its recently issued UK R&D Roadmap, the Government said that it would 'take greater account of place-based outcomes on how we make decisions on R&D in the UK, ensuring that our R&D systems make their fullest contribution to our levelling up agenda'.¹⁹

The Roadmap also said that 'This could include building on the Strength in Places Fund'. As this R&D scheme, which was announced by the Government in its Industrial Strategy White Paper published in November 2017, was set up to support the development of regional technology clusters, building on this scheme would certainly be the most effective way of delivering the Government's levelling up strategy.

The Strength in Places Fund is a UK Research and Innovation (UKRI) funding programme that makes awards to local consortia representing 'economic geographies' across the UK that have existing research excellence and high-quality innovation capability. This is with the aim of supporting clusters of businesses that have the potential to innovate, or to adapt new technologies, to become nationally and internationally competitive. So far £236 million has been allocated to the fund to cover funding for the first two rounds. While there have been calls to significantly expand the programme, long-term funding is still unclear.

It is envisaged that full-stage grants will be between £10 million and £50 million over three to five years, and that £50 million bids will be exceptional. Proposals are developed through a two-stage process with those successful at the initial 'Expression of Interest' phase awarded £50,000 seedcorn funding to develop their full-stage bids. It is possible that projects can be extended, but this will depend on more funding being made available.

The first wave of the fund saw 23 seed-stage proposals selected for development into full-stage bids. Of these, six are from Scotland, Wales and Northern Ireland, 11 involve areas that are covered in part by an MCA, including the Greater London Authority or non-MCAs, while six proposals are from areas not covered in part by an MCA (see Box 1 for more details).

Encouragingly, a number of the projects appear to provide a relatively coherent package of investments in R&D, developing the necessary infrastructure (e.g. demonstration facilities/test beds) to facilitate its commercial application, building supply chain capabilities and workforce development, and a focus on building the connections between the various actors in the cluster.

Box 1: Projects currently receiving funding from the Strength in Places Fund

As of July 2020, £186 million had been allocated to seven projects, backed by further £230 million from private firms and research institutions.²⁰ Of these, two are in Scotland, one each in Wales and Northern Ireland, and three in England (two in areas covered by MCAs).

Projects include:

- Building a world-leading compound semiconductor cluster in **south Wales** by investing in a co-ordinated package of technology, R&D and training to further integrate the region's science and technology base with its growing strengths in advanced compound semiconductor manufacturing.
- Decarbonising maritime transportation through the creation of the UK's most advanced composite design and manufacturing facilities in **Belfast Harbour** to prototype and demonstrate novel technologies.
- Developing a global centre of excellence in open banking in **Edinburgh**, bringing together Scotland's universities, financial services and financial technology sectors, and investing in developing ethical standards, data repositories and infrastructure, novel business models, and training.
- Translating cutting-edge science and innovation in **Glasgow** into real-world precision medicine applications through the creation of a living lab that brings together the necessary actors and helps to demonstrate novel technologies in a clinical setting.
- Delivering integrated solutions for human infections by establishing a national centre of excellence in **Liverpool** focused on developing a progressive repository of methodologies and improved models for product development for infectious disease prevention and treatment, and validated platforms for early stage product testing and evaluation.
- Building on the creative media production, technology and research strengths of the **Bristol** and **Bath** region through investments in major new collaborative facilities, innovative R&D programmes and the talent pipeline.

Developing **Kent** and **Medway** as the UK's leading region for the climate-smart production and processing of high-value foods and plant-based compounds, helping the cluster to adopt technologies such as artificial intelligence, automation and smart packaging to improve efficiency, minimise/re-use waste, and produce safe, affordable products.

On the basis of the progress made to date it would seem right for the Government to go ahead with the first round of projects while adjusting subsequent rounds to bring them in line more closely with their policy of seeking to level up the economic growth performance of the lower value-added per capita regions of the country.

There would at first sight, however, appear to be four changes that should be made to the scheme.

- 1. Longer-term funding options:** a decision about the longer-term funding of the scheme needs to be made. Equally, the grants should be made for a period of 10 years. If universities and firms are going to recruit new people, start new programmes and fund new organisations to support the development and scaling-up of new technologies, they need the security of 10-year funding.
- 2. Focus on places that have potential:** there should be changes in the criteria by which projects are judged. A key criterion must be whether there is already in existence a cluster that with support can be made globally competitive. It is a waste of money to put resources into a project that is simply aspirational. At the same time, the research proposals should be judged by whether they will help the cluster involved become globally competitive rather than simply by their research excellence.
- 3. Priority to be given to places that have the potential to level up:** if this scheme is going to be seen as central to the levelling up policy of the Government, it should be restricted to mid to lower value-added per capita MCAs. The type of projects supported by this scheme need to have the backing of an MCA, and by restricting the grants to MCAs it provides an incentive for local authorities to become MCAs. It makes no sense to use this programme to support projects in the Greater London Authority area, for example, which already has a disproportionately high level of R&D funding.
- 4. Scientific judgement:** the panel of judges of the projects seems to be largely composed of scientific research academics with one business person. There would seem to be a strong case for including a number of business people or venture capitalists with strong high-tech backgrounds, who could make judgements about whether realistically projects will be able to create globally competitive clusters.

- 5. Replacing EU funds post-Brexit:** The less developed regions and nations of the UK have also historically benefited from significant investments in R&D through the European Regional Development Fund (ERDF). Over the period 2014 to 2019, ERDF invested £470 million in research and innovation as part of its £2 billion investment programme in the UK.

As part of the process of leaving the EU, the UK Government committed to creating the Shared Prosperity Fund to reduce inequalities between communities, replacing (at least in part) the lost EU Structural Funds (of which ERDF was a part). This provides a unique opportunity to reconfigure this type of funding programme to support levelling up across the UK.

The development of the Shared Prosperity Fund should ensure strong coherence and complementarity with UKRI's Strength in Places Fund and commit a significant proportion of its budget to supporting the development of leading industrial clusters around the UK, where the investments required to unlock potential and drive regional value capture are outside the remit of the Strength in Places Fund and UKRI.

05

The role of central government

The Department for Business, Energy and Industrial Strategy should become the lead department for levelling up

In order for the policies set out in this report to be successful, not only would it be necessary to give more powers to the MCAs, it would also be necessary for the Government to co-ordinate its own actions more effectively. This will only happen if one department is made the lead department. In the past, no one government department took full responsibility for the Regional Development Agencies. This led to them being much less effective than they should have been.

As the main aim of the regional economic growth programme would be to level up the prosperity of the regions, and as it is important that the programme is closely connected with the other work of the Government on economic growth, the best department to lead this programme would appear to be the Department for Business, Energy and Industrial Strategy (BEIS).

If this route were taken, it would, however, be necessary to inject some more industrial and technological expertise into the Department. A way that this could be done is by appointing an experienced industrialist to be a Special Adviser in the Department, with a brief to strengthen the team of civil servants implementing the regional economic growth programme by bringing in industrialists, and experienced scientists, engineers and technologists.

Better co-ordination among national departments is required

If this initiative is to be successful its work will also need to be closely connected with the work of the Department for Education, the Ministry of Housing, Communities and Local Government, and the Department for Transport.

In order to achieve the necessary co-ordination, a National Council of Innovation could be set up to oversee the regional economic growth programme and the Government's Industrial Strategy, and the Council could have on it the Ministers for BEIS, Education, Local Government and Transport.

It would also perhaps be desirable to have on the Council a number of industrialists and a representative of the venture capital industry, the Chair of UKRI and perhaps the Vice-Chancellor of one of our top science-based universities, to show that this is not just a government initiative but a national one. As such a Council would inevitably play a key role in the Government's economic policies. There would also be a case for it being chaired by either the Prime Minister or the Chancellor of the Exchequer.

As well as taking forward forcefully the Government's regional economic growth policies, the Council could also be given responsibility for the Shared Prosperity Fund which the Government is committed to setting up to replace the funding previously received from the ERDF. As the main purpose of the Shared Prosperity Fund would be to support regional economic growth, giving responsibility to the Innovation Council would make sense organisationally and financially.

The Innovation Council could also be used, if the Government wished, to drive forward the rate of innovation in the economy and the resulting increase in productivity. There are five areas which could very obviously benefit from concerted government action.

They are, firstly, the **Small Business Research Initiative**. Modelled on the American scheme, this has been successful in supporting innovation in small businesses but could be improved and expanded. Secondly, the use of **government procurement** to support innovation has never been effectively implemented by government departments and needs to be driven forward.

The third area is the development of our **renewable energy industries**, and the fourth is the Government's support for the **diffusion of the technology** and methods of Industry 4. Almost all governments today have major Industry 4 initiatives, compared with which ours is totally inadequate.

Finally, the Government's exciting and important **R&D Roadmap**. If the major benefits of this programme are going to be maximised it again needs the energetic and enthusiastic support of the whole government.

The creation of the Innovation Council would obviously be a significant change to the way that the machinery of government normally operates. But if the regional economic growth programme is to be successful such a major organisational change would be necessary, and it could be put in place quickly and with little disruption. It would also signify very clearly the Government's determination to level up the economic growth of the regions.

06

Appendix — How other countries have supported clusters

When considering how the UK can support clusters it is useful to keep in mind what other countries have done to support successful clusters in their countries.

(a) The Hsinchu Science Park – Taiwan

In 1962, Taiwan's GDP per capita was US\$172, less than that of Ghana. Today, Taiwan is a prosperous country with its companies producing the majority of the world's notebook computers, motherboards, monitors, optical scanners, power supplies, and a range of other electronics related products. In addition, the island's semiconductor foundries account for two-thirds of the global foundry output.

So how did this small, and initially very poor island of 24 million people come to overtake other Asian economies in global technology competition? At the start, Taiwan's political leaders made substantial investments in technical education. The capabilities of Taiwan's public research institutions were also upgraded. Taiwan's Ministry of Economic Affairs established the Industrial Technology Research Institute (ITRI) in 1973 to provide joint research, technical services and advice to Taiwan's small- and medium-sized enterprises.

A major opportunity for ITRI based in part on advice from oversea Chinese experts in the United States, was the semiconductor industry, and in 1974 ITRI officials created the Electronics Research and Service Organization (ERSO), a subsidiary devoted to research in semiconductor manufacturing and commercialisation. By 1987, ERSO had a staff of over 1,700 and a budget of about US\$100 million.

Then, in 1980, based on visits to Silicon Valley in the 1960s and 1970s, and advice from the region's community of US-educated Taiwanese engineers, the National Science Council sponsored the Hsinchu Science Park in order to attract foreign and overseas Chinese investments in research-oriented companies. The park was located near to two leading technical universities, National Chiao Tung and Tsinghua, and ERSO's labs were

moved to the area. In the early 1980s the Ministry of Finance also created the institutional framework for a Taiwanese venture-capital industry in order to provide funding for the research-intensive production it wanted to attract to the science park, as well as to stimulate the development of a public capital market.

As a result of these initiatives, the 1980s saw the emergence of an indigenous IT industry. There were two separate clusters of entrepreneurship: a large number of small firms and start-ups in the Taipei area began cloning PCs and components, while at the same time a small number of integrated circuit manufacturing and design start-ups were spun out of ERSO.

It was not until the 1990s, however, that local firms began to differentiate themselves on the basis of innovation and skills, rather than low-cost labour. This was due to the impact of government policies and the 'reversal' of the brain drain, as thousands of Chinese engineers who had been educated and worked in the United States were encouraged to return.

The results have been impressive. In 1983, the park had 37 firms. By 2016, there were 487 companies with combined sales equal to about 6 per cent of the entire Taiwanese economy. Employment at the park is 2.3 per cent of national employment, yet the park is estimated to contribute to 15 per cent of GDP. Patents in the park in 2010 accounted for more than two-fifths of total patents for the nation of Taiwan.

The clear leader of the pack is the semiconductor industry, which accounts for roughly 75 per cent of sales made by companies in the park, and which has powered Taiwan as an export-led economy. With annual sales exceeding US\$70 billion last year, the semiconductor industry accounts for about 40 per cent of exports. Taiwan officials argue that semiconductors will keep Taiwan's estimated US\$131 billion high-tech industry strong despite competition from China and elsewhere.

An important point to note about the success of the park is the link from R&D to production. When it was first conceived, it was intended as a high-tech park focused on R&D work, but much of the success of the park has stemmed from bringing research and production together. R&D and technology development account for 40 per cent of employment in the park, with production, manufacturing, advertising, and other employment accounting for the other 60 per cent.

(b) Innovation Superclusters – Canada

The Innovation Superclusters Initiative, launched in 2017 is a unique Canadian initiative. The Government of Canada is working with industry in new ways – through a business-led partnership model – to align the efforts of diverse industries, researchers and intermediary institutions, and build deep, ecosystem-level advantages in regions across Canada. The Innovation Supercluster Initiative is strengthening clusters of existing commercial strength, pulling in a range of highly innovative industries, small- and medium-sized enterprises as well as industry-relevant research talent, to create the conditions

required to develop superclusters that reflect Canadian excellence and world-class leadership.

Investments are intended to accelerate commercialisation, strengthen capacity in strategic platform technologies, help tackle challenges of importance to industry and take advantage of new opportunities to boost the productivity and competitiveness of Canada's sectors of economic strength.

The investment of up to C\$950 million, which will be matched dollar for dollar by the private sector, is expected to create more than 50,000 jobs over 10 years and grow Canada's GDP. Innovation superclusters were selected following a two-phase application process. Five Innovation Superclusters have been awarded a total of C\$950 million (£538 million) over five years. Together, they involved 60 academic institutions and more than 450 businesses. The five superclusters include Digital Technologies, Protein Industries, Advanced Manufacturing, AI-Powered Supply Chains, and Ocean.

The approach had to leverage strengths, address gaps, and incentivise innovation ecosystem players to work together more strategically around five themes of activity for the collective benefit of the cluster:

- Technology leadership (mandatory) – collaborative projects that directly enhance the productivity, performance and competitiveness of member firms.
- Partnerships for scale – activities serving a target group of cluster firms to enable their growth, including by increasing domestic demand for cluster products and services or by facilitating expansion.
- Diverse and skilled talent pools – activities enhancing regional labour force skills and capabilities or initiatives addressing industry needs for talent.
- Access to innovation – investing in and providing access to assets, services or resources that benefit a range of cluster firms over a period of time.
- Global advantage – activities and initiatives that position the cluster and its strengths as world-leading, enable firms to seize market opportunities, and attract international investments and partnerships.

(c) Biopolis – Singapore

It was only in 1997/98 when the Asian financial crisis resulted in a large and sudden drop-off in the number of foreign patients who traditionally went for treatment to Singapore's private hospitals, that the hospital industry decided that medical research was critical to its survival. The importance of this was confirmed by the response of Singapore to the severe acute respiratory syndrome (SARS) epidemic in 2003. The virology laboratory at Singapore General Hospital worked on tissue sampling and preliminary analysis, while the Genome Institute of Singapore began to sequence the SARS genome in 2003. By the end of the epidemic no one in Singapore could doubt the relevance of cutting-edge medical research.

The timing was critical because it coincided with the early stages of Biopolis, Singapore's medical technology research park. The park was conceived as a hub to encourage collaboration between major biotechnology companies and public research institutions. Phase 1 of Biopolis consisted of a S\$500 million (equivalent to US\$364 million) 185,000 square metre, seven-building complex, and additional phases have almost doubled that size.

Biopolis now consists of five research institutes under the Government's Biomedical Research Council, focusing on bioinformatics, bioprocessing technology, genomics, bioengineering and nanotechnology, and molecular and cell biology. The centre houses some seven thousand PhD graduates in the life sciences, including some of the world's most distinguished biomedical researchers. To put this in context the total number of life sciences PhDs in the United States is about 10,000.

The park is the epicentre of the growth of the biomedical sciences (BMS) industry, which has become a major contributor to the country's economy. BMS manufacturing output increased by nearly five-fold from S\$6 billion (US\$4.4 billion) in 2000 to S\$29.4 (US\$21.4 billion) in 2012. During the same period, employment grew by more than twofold from 6,000 to 15,700. The industry now contributes approximately 20 per cent of the total value added to the overall manufacturing sector of Singapore.

Singapore plans to pursue this strategy further. In early 2016, Prime Minister Lee Hsien Loong, Chairman of the Research, Innovation, and Enterprise Council, announced an 18 per cent increase in the nation's 2016 to 2020 research budget over the previous five-year budget, to 1 per cent of the country's gross domestic product, a percentage on a par with that of other industrialised countries. In addition, the National University of Singapore opened a S\$25 million (US\$18 million) synthetic biology centre in September, 2015.

It is initiatives like these that explain how, in terms of GDP per capita in international dollars, Singapore in 2017 (according to World Bank figures) ranked fourth in the world behind only Qatar, Macau and Luxembourg – with a GDP per capita figure of 94,000 Int \$. On the same basis, the United States came 11th, with a GDP per capita of 60,000 Int \$, and the United Kingdom came 24th, with a GDP per capital of 44,000 Int \$.²¹

(d) Chinese Science Parks

While the definition of a research park is not the same everywhere, China is currently estimated to have 54 'science and technology industrial parks', totalling 60,000 companies with eight million employees. These parks contributed 7 per cent of China's GDP and close to 50 per cent of all China's R&D spending, and China's national R&D strategy is structured around these parks.

The research park strategy was started in Zhongguancun in Beijing and was the brainchild of Chunxian Chen, a former scientist in the Chinese Academy of Sciences who soon after economic reform began in 1978, along with 10 fellow CAS researchers, took academic tours of the United States. These included visits to Silicon Valley and Route 128.

The park got off to a slow start, but an early success emerged when Chen's fellow researchers at the Chinese Academy of Sciences started a computer business, Lenovo, in 1984. CAS provided them with the initial capital of US\$24,000 and the business was started in Zhongguancun. Today, the company employs 55,000 people with revenues of US\$43 billion.

By 1986 there were one hundred start-ups in Zhongguancun, and the Government approved the establishment of Zhongguancun as an experimental zone for the development of high and new technology, and the growth thereafter was exponential. Today the park covers more than 100 square kilometres and is estimated to house 20,000 companies with 250,000 employees.

Close to some of China's most prestigious universities and research institutes, Zhongguancun enjoys great advantages in access to talent. The Haidian Park of Zhongguancun is home to more than 40 universities, including the world-class Peking and Tsinghua Universities, as well as more than 200 research institutes and national-level laboratories.

The success of Zhongguancun led to the development of the national Torch Project of the State Science and Technology Commission in 1988. Its purpose was to construct the science-and-technology industry parks to incubate new start-ups in Zhongguancun and China in general. It was hoped that by building science parks, the R&D institutes, universities, and start-ups could work closely together to commercialise the innovation that rolled out of national science and technology projects. This project has resulted in the 54 research parks now found throughout China.

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