Back to the Future? UK Industrial Policy after the Great Financial Crisis

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Abstract: In the aftermath of the Global Financial Crisis (GFC) (2008), debates began to shift towards perspectives on the 'rebalancing' of mature economies with a particular emphasis on promoting more sustainable productive activities. In the UK, this led to an initial acceptance – among some policy makers - that the state could in a positive way, utilise 'industrial policy' to revitalize manufacturing. However, while some of the early industrial policy initiatives - such as the Automotive Council and the Catapults - have been promising, the Coalition and then Conservative government's stance on industrial policy has been at best 'muddled' and at worst, is often 'empty rhetoric'. In this chapter, we explore and evaluate the role of UK industrial policy since the GFC, paying particular emphasis upon initiatives at technological, regional and sectoral levels. We conclude with some suggestions for the future course of UK industrial policy, in the post-Brexit era, given the government's recent green paper.

Keywords: industrial policy, smart specialisation, regional development, innovation.
JEL Classification: L50, L52, R11, L60

1. Introduction[1]

In the aftermath of the Global Financial Crisis (GFC, 2007-2008) and the ensuing Great Recession (2008-2013) there was a rekindling of interest - particularly in the UK but also across the wider European Union (EU) - in 'industrial policy' (or to use the modern parlance, 'industrial strategy'). This revival of industrial policy into the UK political lexicon represented a sharp departure from the neo-liberal economic model, which had initially arose in the USA and UK, and had become entrenched in socio-economic policy-making since the late 1970s. The neo-liberal model, with its overly-zealous emphasis upon privatisation, de-regulation and free-market fetishism (with a limited role for the state) had finally unravelled to be nothing more than a chimera for delivering long-run, inclusive and sustainable prosperity (Bailey et al., 2015a). In contrast, the recent comparative success of the BRICs (Brazil, Russia, India and China) and previously acclaimed industrial policies of countries such as Japan, South Korea and Germany gave credence to the role of the state in economic development (Chang, 2002a and b). In the UK, this new dialogue around industrial policy was underpinned by genuine concerns - among many economic commentators and policy-makers – over perceived challenges posed by a weak and fragile UK economy, ridden not only not by high levels of public and private debt but also by systemic imbalances, a much reduced manufacturing capacity and long run deterioration in its trade balance and growing regional inequalities (Wade, 2009; Cowling and Tomlinson, 2011a; Hutton and Lee, 2012). Indeed, the political desire for a re-balancing of the UK economy was given particular prominence when - in closing his 2011 budget - the then Conservative Chancellor George Osborne, proclaimed his vision for a 'march of the makers' (Hansard, 2011).

Industrial policy itself is a wide-ranging concept. Pitelis (2015), for example, offers an encompassing, contemporary definition, referring to industrial policy as "*a set of measures taken by a government that aim to influence the performance of firms, sectors, industries, and clusters towards a desired objective as well as the financial, human and organizational resources, and organizational and contingency arrangements made in order to implement this objective" (p. 18).* Such measures would include (but are not limited to) support for 'infant industry', trade policies, science and technology policies, state procurement, regulation (and de-regulation) and anti-trust policy, merger policy, policies in relation to foreign direct

[1] We would like to dedicate this Chapter to the memory of Professor Keith Cowling (1936-2016), who inspired both of us and many others in the field of Industrial Policy.

investment, intellectual property rights, the allocation of financial resources and, in recent years, the development of clusters and regions (see also Cimoli et al., 2009). While traditionally such measures have supported manufacturing, modern industrial policy recognises (and supports) sectoral interdependencies *"between manufacturing and services, and even agriculture" (Pitelis, ibid., p. 18).* There is also a distinction between *vertical* industrial policies that are geared towards supporting specific sectors and *horizontal* industrial policies which are non-discriminatory and aim to promote an enabling and competitive environment for business growth (Bartlett, 2014). For policy-makers, the salient question is to assess the scale (and likely effectiveness) of all types of industrial policies in meeting desired objectives before their implementation.

With industrial policy, after a long hiatus, apparently back in vogue, the main challenge since the GFC has been in the design of an appropriate industrial policy framework to re-balance the UK economy. This objective has been given greater credence as it is recognised that manufacturing is a key source of innovation and productivity, while countries with stronger manufacturing bases were not only more resilient (to the GFC) but have been able to reset their economies more quickly. Since 2008, successive UK governments have introduced a range of industrial policy initiatives largely focusing upon sectors, regions and technology. Some of these responsibilities now come under the remit of the rebranded (2016) UK Department for Business, Energy and Industrial Strategy (BEIS).

Yet, almost a decade after the GFC there remains much ambivalence about the UK government's industrial policy. Furthermore, since the GFC, leading business and economic indicators have worsened. Business investment has been sluggish (falling again in the last quarter of 2016), and remaining below its pre-GFC peak (ONS, 2016). This has translated into a poor UK productivity record which (in 2014), was 18% below the average productivity performance of the other six countries comprising the G7 (Guardian, 18/2/2016). Similarly, industrial output (a broad measure including mining and quarrying) remains 8.1% lower, while manufacturing output, in particular, is 4.7% lower than in February 2008 at the onset of the GFC (ONS, 2016). Indeed, since the GFC manufacturing has entered several sporadic periods of recession (Guardian, 11/5/2016). The UK's long running trade deficit also reached an unprecedented (post-World War II) high of 6% of GDP in the final quarter of 2015 (Guardian, 31/3/2016). More broadly, Blanchflower (The Independent, 3/8/2014) described the UK's economic recovery (from the GFC) as the slowest on record since the South Sea Bubble crisis of 1720. The situation has become even more critical in the context of the result of Brexit

referendum held on the 23rd June 2016, and recent indications from the UK Prime Minister, Theresa May, that the UK will leave the EU single market could have significant implications for the UK's manufacturing base (Bailey and De Propris, 2017). Partly to militate against the risks of Brexit, the government recently published a new green paper entitled 'Building our Industrial Strategy' (HMG, 2017).

In this chapter, we explore and evaluate the role of UK industrial policy since the GFC, focusing specifically upon three core areas; technology and innovation, places and sectors. We begin in section 2 by exploring historical perspectives, especially the evolution of industrial policy in the UK and the EU (and wider world) since the Second World War. Section 3 provides a comprehensive review of UK technology and innovation policy, focusing specifically upon the introduction of the catapult centres, while section 4 looks at the notion of smart specialisation and developments in 'place based' regional policy. Section 5 then examines recent UK sectoral policy initiatives (using the automotive sector as a case example). In section 6, we then consider the issue of Brexit and the likely impact of leaving the single market for UK manufacturers, before commenting on the prospects for the government's newly launched industrial strategy green paper, where we offer some of our suggestions for ways forward. Finally, section 7 offers concluding remarks.

2. Historical Perspectives

The rationale and focus of industrial policy in developed economies has evolved considerably over the last 80 years. In the immediate aftermath of World War II, arguments around (developing) infant industries and a new desire for state ownership and (more) state planning were in favour (Warwick, 2013). This reflected both the changing socio-political climate - in the UK a distinctly socialist government was elected in 1945 – and the economic necessity to restore the foundations of war-time economies where the consensus was that market forces (on their own) were unable to deliver stable growth (Coates, 2015). This was the 'golden age' of Keynesian macro-economics, Bretton Woods and relatively 'managed' international trade and investment flows; governments had – or appeared to have – some degree of control over policy levers and the direction of the economy (Booth, 1983).

During this era, industrial policy was predominantly 'vertical' or - as Warwick (2013) puts it - 'selective', being targeted on specific sectors and industries. Policy was a mix of nationalisation and other forms of state aid and 'hard' policy instruments – such as direct subsidies, tariffs/quotas and use of state procurement - to benefit particular domestic firms and industries

(Pryce, 2012). The selection criteria were often discretionary, being in part a government desire to strategically 'pick winners' (in 'sunrise' industries) and thus promote 'national champions' and in other cases to safeguard employment in (regional) industries in long term decline. The most proactive countries adopting such measures were, in Europe, France and in the Far East, Japan which by the late 1970s and - through clear state administrative guidance - became the world's second largest economy (see Johnson, 1982; Bailey et al., 2007). In the UK, the peak point of this type of (vertical) industrial policy was the period 1964-1979, where both the Wilson and Heath governments enacted a series of selective measures to try and avert the UK's relative industrial decline. These measures included partial and full nationalisation of 'failing firms' for which responsibility eventually fell under the National Enterprise Board (NEB) (established in 1975), and whose wider remit was to provide funds for long run industrial investment. The most notable nationalisations in this period were British Leyland, British Aerospace and Rolls Royce, and several firms (typically in financial difficulty) received significant public subsidies, not least Leyland and Chrysler (see Coates, 2015).

It has generally become accepted that the British experience of industrial policy during this period was a 'failure', although interestingly both British Aerospace and Rolls Royce have since become highly successful (private) businesses in their own right. Nevertheless, the approach drew significant criticism, not least that it encouraged rent-seeking behaviour by firms and a high degree of (inappropriate) lobbying by weak (though often large) corporate firms that were losing out in international markets (Baldwin and Robert-Nicoud, 2007). Moreover, there were economic governance issues with the UK government often in a weak position in negotiating with major transnational corporations involved in British industry, who were often reluctant to allow their (global) strategies to become subservient to the wider industrial objectives of the British state (Coates, 2015). In summary, industrial policy became associated with sinking significant sums of public money – in a period of tight public budget constraints – into 'lame duck industries'. This view of industrial policy still persists in some quarters to this day (Warwick, 2013).[2]

[2] The comparative success of Japan is interesting. Japanese industrial policy was largely lauded for its role in developing a modern high-tech industrial economy, with the country nurturing prominent and (globally) successful national champions such as Toyota and Sony (Johnson, 1982). This was largely achieved in an era when the Japanese state was able to exert close strategic control over its companies and industrial base. As (global) markets opened up, these 'national champions' began to increasingly move their operations off-shore, leading to concerns of a hollowing out of the country's industrial base in the 1990s-2000s (Cowling and Tomlinson, 2000, 2011b; Tomlinson, 2002).

The reaction was a retreat from large-scale interventionist industrial policy and instead, with the election of the Thatcher government in 1979, the widespread adoption of neo-liberal economics, which promoted extensive market de-regulation, privatisation and liberalisation. This approach became synonymous with the 'Washington Consensus' since it was widely advocated by the major policy making Washington institutions such as the International Monetary Fund (IMF) and the World Bank (Williamson, 1990). Insofar as the UK had an industrial policy, it (arguably) was 'horizontal' with the role of the state being to facilitate an enabling business environment "*by setting the rules of the game, ensuring the rule of law, and generally creating a market free of preferential subsidies in which all compete on an equal basis"* (Bartlett, 2014, p. 5). These 'horizontal' measures would include generic support for education and skills training, infrastructure and the use of tax incentives to promote entrepreneurship, investment and Research and Development (R&D), with the aim of raising UK productivity (see Warwick, 2013). A critical view is these 'horizontal' measures still held an inherent 'vertical' element, albeit one specifically favouring larger (corporate) firms, who were in a stronger market position to appropriate much of the benefits from such initiatives (see also Christopherson and Clark, 2007). Moreover, vertical policies were still used occasionally and explicitly, especially with regards to attracting inward FDI through public subsidies and other selective 'sweeteners' (such as preferable land sites and reductions in local business rates) to foreign firms, with the Nissan case being a notable example (see Hudson, 2002). Elsewhere, industrial policy was subtly targeted (often through public procurement) – particularly in the USA – towards space and defence led industries (Kitson, 2005).

Nevertheless, horizontal industrial policy became the only permissible obvious means of intervention in the rules governing the EU single market; an initiative in which the UK was at the forefront, and launched on 1st January 1993. The single market prohibited direct state aid to firms and industries and, among other things, had strict rules regarding public procurement to ensure equal treatment and transparency (across the EU) in awarding contracts to private operators in the public sector. This, arguably, nullified the ability of EU nation states favouring domestic firms (Sánchez Graells, 2015). From the late 1990s onwards, EU and, by association, UK industrial policy moved more towards decentralised (horizontal) territorial policies through EU regional policy and the use of the European Regional Development Fund, which was part

of the EU structural and investment funds (Begg and Mayes, 2000).[3] In this regard, EU industrial policy begun to be largely influenced by what Warwick (2013) refers to as a 'systems approach', which emphasises the importance of the generation, absorption and exploitation of knowledge as the source of growth. This is very much rooted in endogenous growth theory, theories of spatial learning and clusters (the 'learning economy'), and Schumpetarian institutionalist and evolutionary theories of growth; as such it represented a (nuanced) departure from neo-classical economics, which viewed the world as 'flat' with knowledge easily (and widely) disseminated. Instead, the systems approach views knowledge as "*heterogeneous, context [space] specific, tacit and sticky…with actors facing uncertainty, to which they adapt"* (Warwick 2013, p. 21; *own words in italics).* Thus to facilitate innovation led growth, the EU - through the Lisbon Agenda (2000) - set out to promote regional innovation systems, and facilitate improved networking among (largely local) actors in regional clusters and closer links with public research and higher education bodies to enhance 'learning' and 'knowledge transfer' (see also Bartlett, 2014).

The Lisbon strategy (2000), however, failed to improve EU (and UK) competitiveness or facilitate an inclusive and sustainable growth path. In part, it struggled with a lack of compliance and policy co-ordination across Europe; a reflection of a fragmented set of policy instruments and a lack of an overall cohesive industrial strategy (Tausch, 2010). The underlying policy framework remained largely underpinned by a neoliberal logic and notion of comparative advantage, where developed high-cost EU countries could specialise in (high value added) innovative value creation activities (i.e. research, design, marketing and logistics), while commoditized manufacturing would be sourced from low-cost emerging economies, particularly in Asia. The extent of this international division of labour saw a decoupling of innovation and manufacture, leading to an erosion of the EU's industrial base and, in a number of EU countries – the UK being a prime example - an over-reliance upon untradeable sectors that left these economies more vulnerable during the GFC. Recent research has suggested manufacturing processes and innovation are in reality not that easy to decouple and be relocated independent of each other. Off-shoring can thus pull along more innovation-intensive and destabilise EU's innovation base (as has occurred in pharmaceuticals, advanced engineering

[3] For further details of the EU Regional Development and Cohesion Funds and how these funds are allocated and programmes evaluated see http://ec.europa.eu/regional_policy/index.cfm/en/.

and ICT); the demise of manufacturing results in an impoverished 'industrial commons' (Pisano and Shih, 2009; Ketovivi and Ali-Yrkko, 2009).

More broadly, since the GFC, and in an effort to rebalance economies, both the EU – in its Europe 2020 strategy - and the UK have begun to revisit the notion of vertical industrial policy and 'non-neutral' modes of intervention, while seeking to maintain a 'level competitive playing field'. In the UK, this has seen a range of (inter-related) initiatives at sectoral and regional levels and in technological domains. The following sections provide a comprehensive review, starting with technology and innovation policy.

3.0 Technology and Innovation Policy

3.1 Rationale and Innovate UK

The rationale for the state to have an active Technology and Innovation policy is well established and stems from a series of market and systemic failures (Stoneman and Vickers, 1988). An important adjunct is any public investment in innovation activities has to demonstrate 'additionality', i.e. it needs to demonstrate an (socio-economic) impact over and above what the private sector would achieve without any (state) intervention (see Luukkonen, 2000). This requires policies which target technological domains where there are barriers to private sector activity, and for which there are significant socio-economic benefits.

The market failures leading to sub-optimal private sector investment in R&D and innovation activity are multi-faceted. They include the higher levels of uncertainty associated with the time scale and (long run) potential returns to innovation. This issue becomes particularly acute in economies such as the UK, where the lack of patient finance (for innovation) is perceived as an endemic problem (Mazzucato, 2013a)[4]. In addition, the public goods element of innovation and the potential for (positive) knowledge spill-overs means it is impossible for private firms to appropriate the full value of their R&D investments; thus they will tend to underinvest and R&D will be conducted in a closed manner. There may also be natural monopoly considerations, where some technologies with high fixed costs and (potentially dynamic) increasing returns to scale prohibit (wide) private sector investment in R&D; product market

[4] UK industry has long been over-reliant upon short term (equity) capital, where there is an over-prevalence of investment incentives favouring short-term (equity) market movements at the expense of financing long term investment, support for growing SMEs and long term value creation (see Kay Review, 2012, and also Sawyer, 2015). The UK Treasury is currently undertaking a new review into patient finance which is being led by Sir Damon Buffini (Telegraph, 21/11/16).

demand is such that only one firm can be supported. This is especially true for SMEs, but also holds for larger firms when other factors such as uncertainty are also taken into account (Stoneman and Vickers, 1988). The market may also not be able to co-ordinate effective collaboration (over innovation) between firms, universities and state agencies at national and international levels; the state may act as a neutral convenor to connect and build such links to enhance innovative activity. Incomplete information (and lack of knowledge) about new technologies and their applications hampers market demand and can inhibit profitable R&D and technological diffusion. Again, state agencies can help to bridge this gap, by validating and demonstrating technologies to boost market confidence (Hauser, 2014). Finally, there is a role for the state to address wider societal missions that go beyond the private/social wedge and where a (very) long term vision is required (Mazzucato, 2013b). These include state (and supra-national state) funding – and indeed from international funding - for major (macro) projects from space discovery and the development of the internet, to the design of more efficient transport systems and harnessing satellite data to better understand climate change and predict climate events.

The UK faces a something of a conundrum. It is a respected world leader in scientific research, hosting four out of world's top ten universities and has a citations record second only to that of USA. However, the country's ability to translate new knowledge into commercial products and services is relatively weak, with (low) levels of expenditure in this stage of technological development no more than a small country such as Finland (Hauser, 2014). Moreover, since the early 1990s, total UK investment in R&D has remained static at around 1.8% of GDP, well below that of competitor nations such as the USA, France and Germany which are closer to 3% and South Korea at 4.0%. This reflects the fact that research intensive sectors comprise a smaller part of the UK economy (vis-à-vis other nations) and the UK having lower levels of research conducted within these sectors. There are also concerns about significant UK weaknesses in basic skills, particularly in the science, technology and engineering (STEM) subjects (BIS, 2014). Low UK innovative capacity in turn translates into a low productivity-low wage economy.

The responsibility for the implementation of UK innovation policy largely resides with Innovate UK - formerly the Technology Strategy Board (TSB) – a non-governmental public body which was originally established in 2004. Innovate UK is the prime agency for prioritising funding (and supporting) UK innovative activity. Since 2007, it has committed over £1.8

billion to innovation projects, which has been matched by a similar amount in partner and business funding, and assisted more than 7,600 organisations with projects, contributing over £11.5 billion to the UK economy and creating 55,000 extra new jobs[5]. One of Innovate UK's main partners is the Knowledge Transfer Network, which seeks to connect firms, universities, funders and other agencies to stimulate innovation. Innovate UK also oversees and partially funds the UK Catapult Centres and is playing a significant role in framing the UK's smart specialisation strategy (see section 4). These have been the two major UK technology and innovation policy initiatives since the GFC and we consider these in further detail below.

3.2 UK Catapult Centres

The UK Catapult Centres are a relatively new network of elite technology and innovation centres with a remit to 'transform great research into commercial success' (TSB, 2013). They arose out of the Hauser Report (2010), which was commissioned by Lord Mandelson (then Secretary of State for Business, Innovation and Skills) towards the end of the last Labour government, 1997-2010) and examined the operation of Technology and Innovation Centres (TICs) across 12 countries. The Hauser Report noted how TICs were prominent in innovation ecosystems (in these countries) and typically focused upon a specific (scientific) domain, acting simultaneously as knowledge mediators and producers. They enabled the building of partnerships between academia, industry, government and other (innovation) intermediaries, and facilitated knowledge flows between scientific researchers and industry. In addition, TICs were able to enhance demand for new technologies among sophisticated buyers through technological diffusion initiatives including demonstration events, seminars and conferences; thus they raise awareness (and confidence) among firms of new technologies that can enhance business competitiveness (see Hepburn and Wolfe, 2014).

The rationale for the UK catapults was to address "*the gap between early stage publicly funded basic research and privately funded research at the commercialisation stage; many (UK) firms had struggled to bridge this void where innovation is stifled due to a lack of translational research in the middle stage of the technological readiness scale*" (Hauser (2014, p. 10). While the UK has a significant number of 'Research and Technology Organisations' (RTOs) operating in various sectors at this intermediate stage of the innovation process, many of these

[5] Details from https://www.gov.uk/government/organisations/innovate-uk/about (accessed 10/3/2017).

"*are capital constrained and [without public support] had become focused upon less risky activities closer to the market in established sectors rather than on emerging technologies and innovation areas which are riskier, but offer larger potential social and economic returns*" (*ibid., p. 13*). This leads to a sub-optimal level of UK (based) investment and activity in potentially fruitful areas of innovation, adversely affecting the nation's growth trajectory.

The UK Catapults are based in part on the successful German *Fraunhofer* model, which began in the early 1950s and with a staff of over 24,500 now operates 67 distinct institutes and research units in Germany (and a further 7 in its American subsidiary in the USA). Like the *Fraunhofer* institutes, the UK catapults focus upon scientific and technological domains where the UK can gain a significant comparative advantage and provide a more direct link between academic research and industry to support the commercialisation of new technologies. In 2010, the New Coalition government committed £200 million over four years to establish six catapults, and as at March 2017, there are 12 Catapult centres; Cell and Gene Therapy, Compound Semiconductor Applications, Digital, Energy Systems, Future Cities, High Value Manufacturing, Medicines Discovery, Offshore Renewable Energy, Precision Medicine, Satellite Applications and Transport Systems (see Table 1)[6]. In a subsequent review, Hauser (2014) has recommended the UK establish around 1 or 2 new Catapults per year, so that by 2030 there will be 30 in total. To fund this objective will require the Innovate UK budget to be doubled to around £1 billion per annum by 2020, though such funding is unlikely to be forthcoming in an era of tight public budget constraints. The criteria for choosing the themes for the Catapult centres – set out by Hauser (2010) – are: (i) a large global market to exploit; (ii) a UK global lead in research capability; (iii) a platform technology of benefit to many UK based companies; and (iv) the necessary absorptive capacity to commercially exploit in the UK.

Insert Table (1) HERE

Each Catapult centre is an independent legal entity, limited by guarantee, and is led by a Chief Executive Officer from industry with a Board composed of business users and experts in the respective technological domain. The Catapults are expected to raise funds equally – in keeping with international best practice - from three sources: (i) business-funded R&D contracts; (ii)

[6] For further details, see https://catapult.org.uk/ .

collaborative applied R&D projects from the UK (research funding councils) and Europe (the H2020 programme) and funded jointly by the public and private sectors (also won competitively); and (iii) core UK public funding (via Innovate UK). This three way split in funding arrangements is to ensure the burden of risks is shared and the centres are allowed to focus upon developing the most advanced (and risky) technologies with the highest commercial potential. In this regard, ongoing public funding is critical to allow the Catapults to undertake research in new (high potential) areas which are either too large or risky for independent private sector actors. While private funding is important to maintain a market perspective, an over-reliance from this source (private funding), might shift the Catapults' priorities towards short-term projects including consulting (rather than R&D/technology transfer) where there are few spill-overs and where there is already an established market. In this regard, the High Value Manufacturing Catapult (HVMC) currently attracts around 45% of its income from the private sector; while industry engagement is welcome, there is a risk that it could shift priorities towards shorter term projects. It is thus important to match this with increased levels of public support to ensure a balanced funding portfolio and the HMVC Catapult maintains a critical mass of activity and capabilities in cutting edge technologies.

In terms of services, the UK Catapults are said to be geared to provide business with "*specialist technical expertise and skills across sectors to SMEs and supply chains, access to high value specialist equipment, facilities and infrastructure, technology and sector leadership, and long term investment in technology platforms or demonstrators"* (BIS, 2015, pp. 6-7). This helps to address the natural monopoly problem, where no single firm (or supply chain) has the capital to finance a facility and its equipment at the leading edge of technology over time; this issue is especially acute for SMEs, who also lack technical know-how. Indeed, the UK Catapults provide unique facilities with equipment often described as being 'one-of-a-kind' in the UK that can assist in the technological development of business and supply chains (Hauser, 2014).

It is far too early for a full evaluation of the Catapults; the programme is a long-term initiative, where the seeds (of investment) may take decades to come to fruition. Indeed, innovation itself is a complex, multifaceted process involving a range of actors, products and processes through which knowledge disseminates and is used in different ways. This is difficult to trace and measure, which means that a holistic approach to evaluation is required (see Aranguren et al., 2016). The government have begun to identify some Knowledge Performance Indicators (KPIs) to capture inputs and activities from each centre to provide early measures of success

(and weakness). The Hauser Review (2014) reports evidence from these early KPIs which suggest the more established Catapults have been able to recruit high calibre staff and are fully engaged in R&D with academia and business, while also making important contributions to skills training through apprenticeships and university research students placements. As the Catapults become more established, Hauser (2014) recommends that more sophisticated KPIs and a transparent performance framework will need to be developed which incentivises impact and engagement with industry, but still ensures Catapults maintain their role as being ahead of the market.

There are several early examples of how Catapults have been demonstrating their 'additionality'. For instance, Hauser (2014) reports how the Cell and Gene Therapy Catapult worked closely with ReNeuron, a leading UK cell therapy firm, on successfully developing (and validating) the manufacturing processes for the CTX stem cell line to be commercially ready. This enabled the company to attract £33 million in new (private) funding allowing it to establish itself as a global leader in stem cell development, while the Catapult acquired new expertise in this area. ReNeuron had been considering relocating some of its operations overseas, but have decided to remain in the UK to maintain the partnership with the Catapult. Indeed, it is anticipated Catapults will act as an anchor for new investment into the UK, as (global) firms will seek to locate their operations in economies with high tech facilities and expertise. This will be especially important in the context of Brexit which sits as a possible cloud on the horizon (see section 6). A key role of the Catapults is in the testing, demonstration and in validation (at scale) of new technologies (for wider societal benefit) in a collaborative process. Thus the Future Cities Catapult in its 'Cities Unlocked' project have been instrumental in bringing together leading private sector actors and charities to test new technologies which assist visually impaired people to better navigate cities. Such partnerships bring different and unique skills (and perspectives) to the innovation process, and build confidence in the technology.

Despite these promising signs, the Catapults still face significant challenges going forward. These primarily relate to funding, not only in terms of ring fencing and extending public funding but also ensuring funding portfolios are sufficiently balanced to protect the Catapults' long term remit. Increasing pressures on the public finances could compromise this position. At the micro level, the Hauser review (2014) also notes the Catapults' current lack of engagement with SMEs. Given the potential role of SMEs as facilitators of innovation, this is

a missed opportunity. In part this reflects a lack of information and knowledge (among the SME sector) about the role of Catapults and how they can assist in SMEs in technology related (business) growth. Overcoming such barriers will require Catapults adopting a dedicated SME strategy, which may include working closely with local government and business groups (possibly in regional clusters) to develop new (SME) partnerships. Similarly, the Catapults links with the research base (particularly universities) will need to become more consistently embedded across the (Catapult) network, with increasing collaboration with international university partners (and other research institutes) (Hauser, 2014). Accessing global sources of knowledge and fusing it with local knowledge expertise can enhance innovation and growth (Bathelt and Cohendet, 2014).

4. Smart Specialisation and Place-based regional policy

4.1 The Concept of Smart Specialisation

One of the main regional policy initiatives to emerge at the EU level since the GFC revolves around the notion of 'smart specialisation'. This is based on the idea that economic units (e.g. sectors or regions) can build on their own comparative advantages to generate new specialisms through the 'discovery of new domains of opportunity and local concentration and agglomeration of resources and competencies in these domains' (Foray, 2015, p. 1). In this way, these economic units can exploit the potential to re-invigorate themselves, enhance their innovation and productivity performance and move onto a more dynamic growth trajectory. The concept itself emerged from the Knowledge for Growth (K4G) network (2005-2009), a group of prominent (innovation) economists appointed by EU Commissioner Janez Potočnik to explore the ways in which policy could enhance European knowledge creation/transfer and promote innovation led growth. It has since assumed a more spatial dimension, in part due to economic geographers and regional studies experts aligning the logic of its' policy framework to the development of clusters and regional systems of innovation (Barca, 2009; Ketels, 2013; McCann and Ortega-Argilès, 2015). Consequently, and in a short space of time, 'smart specialisation' has become the major component in the EU's 2020 flagship 'Innovation Union' programme and wider EU 2014-2020 Cohesion policy - known as RIS3 (Research and Innovation Strategies for Smart Specialisation).

There are significant features of 'smart specialisation', which have a traditional industrial policy flavour. First, it is a return to a more vertical and non-neutral mode of policy in that it advocates prioritising state support for particular technologies, fields or domains identified as

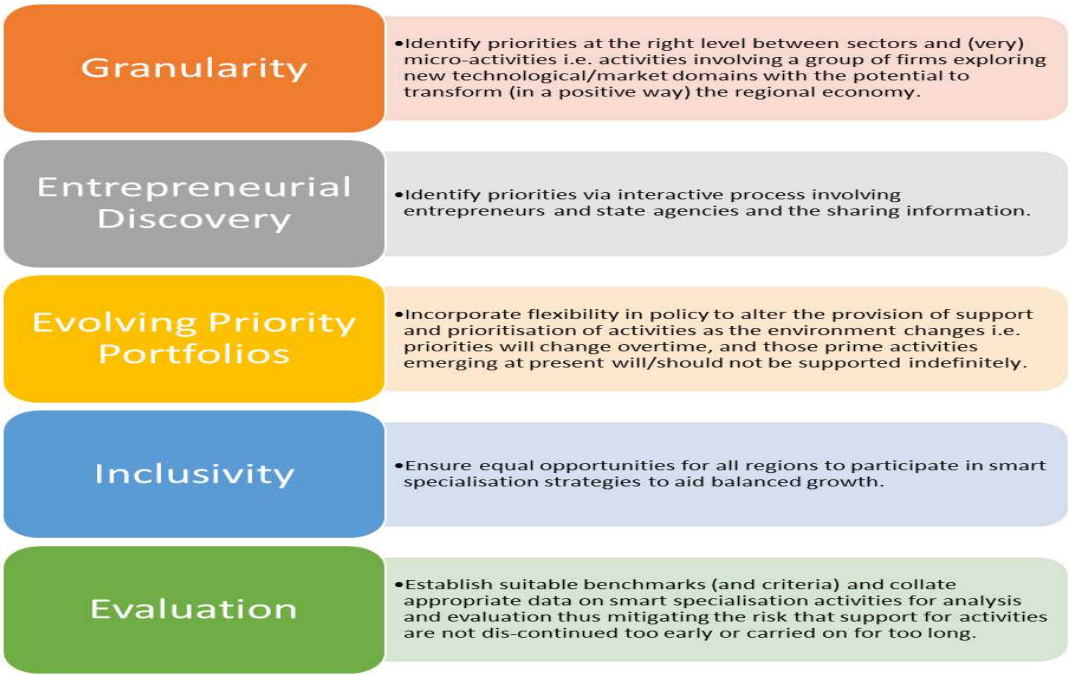
having potential for ‘entrepreneurial discoveries’ which facilitate innovation and commercial exploitation (Foray, 2013). Indeed, the role of entrepreneurs is crucial within the smart specialisation process, since they are often best placed to discover new opportunities (and technological domains). Thus, while the concept does not advocate state support for particular sectors per se, the focus of support is upon specific ‘activities’ (within sectors, technological fields, or at the interstices of sectors) where there is potential for technological development, knowledge spill-overs, scale and agglomeration economies and market opportunities, but which would otherwise be under-funded privately because of classic market and co-ordination failures. These market failures relate to the weak appropriability of private returns from the discovery process (arising from information externalities) and for which the use of intellectual property rights (i.e. patents) is inappropriate. This is because achieving the (much) higher social returns from ‘new discoveries’ (as opposed to a simple innovation, which might be covered by a patent) requires information spill-overs to be maximised and widely dispersed (Hirshleifer, 1971; Foray, 2015). In addition, there are also higher levels of uncertainty associated with the discovery process, causing firms to underinvest and aligned to this, the (weak) access to finance and a higher cost of capital often assigned to such activities (Dasgupta, 1988; Hall and Lerner, 2010). State agencies can help to bridge these funding gaps by assessing the future potential of ‘entrepreneurial discoveries’ and allocating resources to the strongest cases.

Secondly, smart specialisation has also become a place-based strategy (see sub-section 4.2, below), which recognises that ‘new entrepreneurial discoveries’ often emerge from existing technologies and regionally based specialisms. This aligns with the concept – from economic geography – of ‘related variety’ whereby a region is able to unlock its existing expertise, competencies and knowledge bases and fuse these with new, complementary ideas and technologies in adjacent (and related) sectors (see Frenken et al., 2007). Thus, the UK ceramics industry largely based in North Staffordshire is not an example of smart specialisation in practice because of the concentration of ceramics production in the region. However, applied material research activities such as those carried out by Lucideon, the industry’s research centre (through its Applied Materials Research, Innovation and Commercialisation Company (AMRICC), which is based in the region), that seek to transform materials (including ceramics, metals and polymers), processes and technologies into new types of products and solutions to improve industrial efficiency and for commercial use can become a kind of smart specialisation if these new activities attract new firms specialising in this field and bring new competitive advantages to the region (see Tomlinson and Branston, 2014). Such structural changes open up

the possibility of regions moving onto more dynamic trajectories (see also Swann et al., 1998; Menzel and Fornahl, 2010; Asheim etal., 2011; Neffke et al., 2011).

The challenges of smart specialisation primarily relate to the identification and prioritisation of activities for support, while simultaneously harnessing entrepreneurial endeavour and avoiding government failures emanating from bureaucratic, top-down allocation procedures. Foray (2013) offers five generic principles to guide policy-makers in identifying priorities: granularity, entrepreneurial discovery, evolving priority) portfolios, inclusivity and evaluation. These are summarised in Figure 1 and are relatively self-explanatory.

Figure (1): *Foray's (2013) Guiding Principles for Identifying and Prioritising 'smart specialisation' activities*



For regional policy, there is a risk that the smart specialisation logic naturally favours more dynamic regions, where there are greater entrepreneurial and technological capabilities and good networks to facilitate knowledge diffusion. If this translates into the state providing greater support for leading regions (vis-à-vis weaker regions), it can exacerbate regional imbalances and indeed, would run counter to current EU (regional) cohesion policy (McCann and Ortega-Argilés, 2015). Foray's (2013) 'inclusivity' principle (see Figure 1) is thus particularly important, reminding policy-makers to develop mechanisms to ensure there are

equal opportunities for weaker regions (where identifying new activities is more difficult) to put forward suitable cases for support. In practice, this will require carefully targeted (and additional) regional policies to upgrade capabilities (and promote opportunities) within lagging regions. McCann and Ortega-Argilés (2015) provide some guidance based around enhancing skills within existing regionally embedded industries, promoting a (regional) diversification strategy within a specialised technological domain (so as to encourage synergies in related technologies) and improving regional and inter-regional networks to facilitate learning linkages and knowledge flows. Such an approach complements the place based aspects of smart specialisation, being tailored towards building upon a region's existing industrial commons as opposed to the more standard 'one-size-fits all' (spatial-blind) policy solutions (see also Bailey et.al 2015b).

As noted, the European Commission has embarked upon building a platform of services (S3) to support EU regions in their efforts to devise and implement a smart specialisation strategy. In England, this process is largely being overseen by the Smart Specialisation Advisory Hub (S3AH) established in 2014. The Hub works closely with England's 39 Local Economic Partnerships (LEPs) in seeking to identify and target regional smart specialisation projects for state support. Projects earmarked for support are being partly funded by the European Regional Development Fund and the UK's Local Growth Fund. In order to inform decision-making and the allocation of funding, the Hub has thus begun to build a Data Observatory on UK (innovative) capabilities and on where they are concentrated. This is a major challenge since the existing evidence base is fragmented, with data limitations including lags in data release (on innovation capabilities/activities) and limited information on granularity at the sectoral (and regional) levels. In addition, the Hub's analytics also needs to combine hard data on R&D assets, with measures that capture a region's soft capacity such as people, skills and critically the size and quality of networks (which are critical to the success of smart specialisation projects) for which many of the indicators are currently lacking, particularly at the LEP level (S3AH, 2016)). These data limitations can all hinder smart specialisation strategies, which require good, up-to-date data for early identification of emerging technological domains. To militate against this, the Hub is currently involved in a large scale data curation exercise utilising a wide range of secondary data sources (including the UK government's 2015 innovation mapping exercise) and engaging with a range of stakeholders to identify suitable indicators of innovative capacity (and performance) at different levels of geographical

coverage (see Bailey, 2016). This is a work in progress – the data currently collated can be accessed from the Observatory's website.[7]

The place-based emphasis of smart specialisation has meant that LEPs have become the prime focus for identifying and implementing smart specialisation strategies. It however remains to be seen how this all plays out, and as to whether the LEPs will lead (on local innovation) or whether this 'lead' will be largely 'tokenistic' given the majority of LEPs are relatively small in terms of geography and often lack funding to shape a smart specialisation approach (Willcocks, 2014). Consequently, several LEPs (alongside other actors) have begun to collaborate and pool some resources. For instance, the Midlands Engine is a recent collaboration involving 11 LEPs, 86 local authorities, 27 universities and 25 science parks (covering 11.5 million people), that works on collaborative funding bids and on developing the region's innovation eco-system, which includes identifying strengths in science and innovation and building skills, networks and knowledge exchange (Waddell, 2016). The ability of LEPs or not to develop a 'place based' policy is explored below.

4.2 Place-Based vs space blind policy?[8]

It can be argued that the 'back end' of the Labour Administration in office until 2010, and the subsequent Coalition government in office from 2010-2015, began to consider industrial policy more in line with contemporary thinking on industrial policy internationally (see for example, Rodrik, 2004, 2008) and with developments in place based thinking including smart specialisation (described above) at the level of the EU. Under this perspective, industrial policy is viewed as a 'process of discovery' requiring strategic collaboration between the private sector and state where policy ideally has the quality of 'embedded autonomy'. It is not captured by firms and sectors, but focuses on the discovery process, where firms and the state learn about underlying costs and opportunities and engage in strategic coordination. This perspective has close parallels with how modern 'place based' policy has developed.

This is in contrast with 'space-neutral' frameworks long advocated by prominent institutions such as the World Bank (2009), where industrial and regional policy interventions are seen as being of limited value. Under 'space-neutral' approaches, key elements of policy should focus upon space and sector neutral interventions, such as on: (i) supporting disadvantaged people to

[7] Available at: http://smartspecialisationhub.org/observatory/

[8] This section draws on Bailey et al. (2016).

achieve better individual outcomes, through horizontal measures targeted at education, skills and welfare, regardless of where they live; (ii) fostering greater geographic mobility to make it easier for people to move to growing areas; and (iii) reducing the barriers to the expansion of economically successful places (Overman and Gibbons, 2011; Crowley et al., 2012). This approach argues that left to themselves, markets will adjust if the barriers preventing them doing so are addressed. In terms of industrial and economic development, the view is taken that it is better to allow the market to work by itself, rather than for the State to in anyway actively intervene (for example through an industrial policy). Indeed, a smaller public sector is seen as potentially creating more space for the private sector to grow (Faggio and Overman, 2012) and hence is seen as beneficial, whereas industrial and regional policies and their accompanying institutions are regarded as ineffective (Overman, 2012).

A 'place-based' approach sees things rather differently. In part this is because place based approaches recognise knowledge as critical for effective policy development (Barca et al., 2012; Barca, 2011). Yet within this perspective, it is also recognised that such knowledge is not already known either by the state, firms or local stakeholders. As a result, there is a positive role for policy in aiming to stimulate new knowledge and ideas through interactions between local groups (endogenously) and external actors (exogenously) (ibid.) as in the 'smart specialisation' approach described above. In particular, in terms of regional policy it has been used to emphasise the need to exploit related variety, build regional embeddedness and enable strategic diversification (McCann and Ortega-Argilés, 2015). In so doing, it stresses the need for regional actors (government, firms, universities, research institutions) to collaborate, recognising the current starting point for the region in terms of skills, technologies and institutional governance and then to build on these capabilities rather than trying to start 'from scratch' (Wolfe, 2011).

This approach thus sees the capacity of territories to root their economic activity into the local institutional fabric as being at the heart of their economic success, through the generation, acquisition and exchange of knowledge. Yet such knowledge is in turn uncertain and is embedded within localities and needs to be uncovered through participatory and bottom-up processes to build consensus and trust (Barca et al., 2012). Under this approach, the tendency of the 'state' is to lack both an understanding and knowledge of local places (it lacks a 'sense of community' (e.g. Barca et al., 2012; Hildrith and Bailey, 2013; Bailey et al., 2016), with a consequent weakness in its capacity to adapt its approach towards local places and mediate local consensus and trust between local actors as well as to mobilise local resources effectively.

This is no longer about 'picking winners' or propping up failing firms or industries but rather, as the IPPR and Northern Economic Futures Commission (2012) note, about "*seeking to identify and support the elements of comparative advantage within the economy that enable innovation and new technologies to take root and companies to grow" (p. 9).*

In this regard, there is an institutional and capacity failure inherent at the national level in terms of the lack of resources to design industrial policy interventions. As Froud et al., 2011b) note, on industrial policy there is a:

'large gap between the old interventionism of 'picking winners' on the one hand, and the generic neo-liberal enterprise policies that have failed us for the last thirty years. But this is a gap that urgently needs to be bridged. It's an area of ignorance, a knowledge space that needs to be fashioned, if the UK is to start to create the successful industrial policies needed for regeneration' (p. 20).

Given the lack of resources at a national-level to develop such policies, and the capacity constraints of many LEPs outside of major cities, there would appear to be a role for an intermediate tier in bringing 'place' and 'sectors' together in terms of industrial and regional policy development, a point which has been highlighted by the IPPR and Northern Economic Futures Commission (2012).[9] This has examined what a 'northern' industrial strategy might look like, identifying sectoral trends, analysing emerging strengths and opportunities identified by LEPs, and carrying out analysis of the export potential of key sectors in which the North already holds emergent strengths and which can be built on in a 'smart specialisation' sense. Indeed, as the report notes, the results of this analysis offer some cause for optimism: despite an on-going decline in traditional sectors such as manufacturing and extraction, new sectoral strengths are seen as emerging in related fields such as advanced manufacturing, pharmaceuticals and bio-health. The report goes on to note that LEPs and local authorities need to continue to develop their intelligence on key sub-sectors that are seen as having potential locally, but that between the LEP level and the national level there is scope (or space in our terms) for "*a clear northern innovation agenda that is based on a small number of priorities*

[9] At this point, it is worth mentioning the Coalition government (2010-2015) commissioned the Heseltine Review (2012), led by the Conservative peer, Lord Michael Heseltine, who has long been a champion of industrial policy. This report focused upon generating local growth (across the country) and among other things, called for a large £49 billion transfer of central government funding to a Single Local Growth Fund over a four-year period. While a number of small recommendations were accepted/partially accepted by the government, the Treasury largely blocked its major ambitions allocating just £2 billion for 2015/16 as well as in subsequent year of the 2015-20 Parliament (1/6th of that recommended) for local growth initiatives. The implementation has been described as 'disappointingly timid' (see Coffey and Thornley, 2015)

and strategic assets and which addresses some of the North's cross-cutting innovation challenges" (*ibid, p. 9*).

The wider point is that filling this missing space requires regionally-based industrial development strategies promoting 'related diversification'. Such strategies need to recognise (i) the need to bring together different but related activities in a region and (ii) the differing potentials of regions to diversify, due to different industrial, knowledge and institutional structures linked to specific regional historical trajectories. Rather than 'starting from scratch' or applying 'one size fits all policies', regional industrial strategies instead require tailor-made policy actions embedded in, and linked to the specific needs and available resources of regions, starting with the existing knowledge and institutional base in that region. These need to capitalise on region-specific assets, rather than attempting to replicate and apply policies that may have worked in quite different places.

This 'missing space' can also be seen in terms of the industrial policy capacity that has been lost with the Coalition's governments (2010-2015) abolition of the Regional Development Agencies (RDAs). In particular, the removal of RDAs has effectively removed a tier of governance that was – in some cases at least - engaged in attempts to exploit related variety, build regional embeddedness and enable strategic diversification.[10] In essence the subsequent policy 'base' here is 'space-neutral', emphasising the importance of London and the Greater South East (Hildreth and Bailey, 2013; Bailey et al., 2016). It is difficult to see how this shift to a policy of 'centralised localism' will actually help, for example, clusters in mature industrial regions like the West Midlands (or the North) to compete in the high-skill and high-technology niches that they increasingly occupy (Bentley et al., 2010). Indeed, it is in the areas of cluster and innovation policy where there may be particular challenges (Centre for Cities, 2014). Part of the problem is that what remains of industrial policy post-RDAs is centralised in London, where civil servants are removed from events on the ground and - as noted - they generally lack the capacity to develop appropriate industrial policies for the reconstruction of the manufacturing base (Froud et al., 2011a, 2011b). The key point here is that RDAs (which operated between 1998 and 2010) were often better positioned to make sound judgements about how best to offer support and to which clusters (and/or technologies) as they had a superior information base than central government. By way of example, the RDA Advantage West

[10] As one leader of a combined authority stated to us in an interview, *'LEPs talk place but BIS talks sectors'.*

Midlands supported the Niche Vehicles Network, comprising a network of stakeholders across the region which collaborates on the application of new technologies in low-volume vehicle production. This classic open-innovation type approach (Bailey and MacNeill, 2010) is too fine-tuned in scale to have visibility and relevance in Whitehall, yet offers much opportunity for this region's automotive cluster in shifting from low-value volume work to niche high-value low-carbon activities. Here regional-level industrial policy was critical to helping to develop a 'phoenix industry' linked to trends in open innovation, and which might be seen as a good example of place-based 'smart specialisation' in operation (Amison and Bailey, 2014).

An important lesson is that there remains a key role for the coordination of LEPs' economic and cluster strategies, most obviously via some sort of intermediate tier infrastructure. The need for joint LEP working can also be evidenced in the regional data and intelligence legacy of the RDAs. Whilst this was retained in core cities such as Birmingham and Manchester, it is not clear whether other parts of their wider regions (the Midlands and North West) still have access to such data and intelligence. The key point is that if smart specialisation is an important element of place-based approaches, then questions remain as to whether LEPs have the powers, resources and governance arrangements necessary to deliver such an approach. This is especially pertinent if, as Barca et al. (2012) suggest, 'place-based' development strategies require mechanisms which build on local capabilities and promote innovative ideas through the interaction of local and general knowledge and of endogenous and exogenous actors.

5. Sectoral Policies

5.1 The Automotive Case

In targeting certain key sectors again in the wake of the GFC, the UK government has begun - in some sectors (such as automotive and aerospace) - to develop institutions, which seek to bring together government, industry and other actors so as to discover tacit knowledge and then develop appropriate policy instruments. One example is the work of the Automotive Council. The Council is a collaborative effort that brings together Original Equipment Manufacturers (OEMs), government and universities to explore challenges facing the sector. The Council has been involved in a number of work streams, such as developing roadmaps for critical new technologies (which have been used to then guide investment via the Higher Education system and businesses, thus offering a degree of commitment and certainty for firms, and underpinning private sector investment). The Council has also undertaken work on issues such as skills and in attempting to rebuild the UK's fractured supply chains. On the latter, the Council has mapped

the supply chain's relative competitiveness and identified opportunities where UK capabilities can be retained and built upon, for example identifying some £3 billion worth (later increased to £4bn) of potential contracts which car manufacturers would like to place in the UK (Automotive Council, 2012, 2015). So as to exploit this opportunity, the Society of Motor Manufacturers and Traders (SMMT) has tried to bring together assemblers and suppliers to see whether more components can be sourced locally. As the Automotive Council discovered, the main reason why auto assemblers purchase in the UK is proximity (including lower logistics cost, the configuration of parts, and the support of UK-built vehicles) (ibid). However, what components suppliers consider as their competitive advantage, and whether that matches what the view of assemblers, is less clear.

In assembly terms at least, the transport (and particularly automotive) sector has seen a significant upturn in output since 2009, with output rising by over 60%. The sector has also seen around £8bn of investment over the last three years ((The Smith institute and SMMT, 2012; SMMT, 2015). Given the perceived 'reshoring opportunity', the UK's coalition government over 2010-2015 developed, over four rounds, a £245 million Advanced Manufacturing Supply Chain Initiative (AMSCI) to help develop local suppliers around the UK's major manufacturers, with a focus on automotive. The fund was aimed at supply chain companies and could be used for capital expenditure, skills and training, and R&D projects. The scheme aimed to build on an earlier auto-focused Regional Growth Fund bid by several LEPs. While a welcome start, the overall amount of funding on offer (£245 million in total across manufacturing by 2015) was limited. In addition, due to the minimum project threshold value of £2 million, bids often needed to be from several companies clustering together. Extending the scheme so that smaller firms could directly access the support available seems critical, especially when the lack of access to finance is a major issue for such firms.

Critically, access to finance has been a major issue for many firms in the automotive supply chain in the wake of the GFC. The Smith Institute and the SMMT (2012) highlighted a 'window of opportunity' to expand outputs and create jobs in the automotive supply sector, but that access to finance remained a real problem which was effectively thwarting the realisation of such potential *(ibid).* Drawing on a survey of firms operating at different levels in the UK auto supply chain, the report found that 60% of firms were aspiring to grow in the future, one third so rapidly. However, they faced significant financial challenges including: fractured relationships with the banks; a gap in growth finance (many have to fund investment through internal cash-flow); problems in funding tooling development costs; payment and finance

across the supply chain; and the nature of SME owner mangers. The report stresses that, on the whole, the UK banking system has a poor understanding of the sector.

'Tooling up' in the automotive supply chain represented a particular challenge given the uncertainty over future vehicle volumes, the asset specificity of the tool (which means that lenders have been reluctant to accept it as collateral, and a lack of specialist knowledge in the baking system over how to evaluate proposals). In tackling such issues, the report calls for a 'step change' in the engagement of the UK financial sector with the automotive industry. Financial initiatives must be streamlined by the government, the authors note, a taskforce launched to look at finance for tooling up, and a move made towards more long-term policy arrangements to ensure sure finance is available. At some point a dedicated automotive (and manufacturing) loan fund – backed by the state – may be required to overcome failures in the financial system. On this, in mid-2014 the coalition government launched a £24m National Tooling Fund to assist toolmakers and component manufacturers to fund the design, development and manufacturing of tools following a firm order from an OEM. These are small examples of how the Automotive Council began to identify some key challenges in rebuilding supply chains and policy innovations designed to overcome them.

More recently, Sajid Javid's tenure as the UK's Business Secretary was disappointing in terms of sectoral policy. While the Automotive Council continued to operate, Sajid Javid cut several of its functions including a range of previous (modest) interventions to boost skills, rebuild supply chains, and encourage investment in the industry, such as through the Regional Growth Fund, the Advanced Manufacturing Supply Chain Initiative, the Manufacturing Advisory Service (MAS), and MAS' Tooling up Fund to support investment in tools in the Supply Chain. In our view, this was short-sighted, since where policy was reasonably well developed in the sector, it really did make a difference. For example, interventions such as the Advanced Manufacturing Supply Chain Initiative and Tooling Up Fund involved small amounts of public money (£245m and £12m respectively) but had a significant (positive) impact upon the sector.

The ongoing work of the Automotive Council can nevertheless be seen as a good example of how industrial policy can enable firms and government deliver universal benefits. Such activities could usefully be extended, both in the auto case and to other industries (for example, into the Marine Industries Leadership Council, the Industrial Biotechnology Leadership Forum, the Aerospace Business Leaders group and/or in smaller (local) industries such as the Ceramic Development Group), with such groups helping to identify key fractures in industry

supply chains and how to address them. This is no longer about industrial policy 'picking winners', but rather helping the private sector identify weaknesses and then addressing them. The work of the Council is in line with how industrial policy design is conceived of in modern debates (see Rodrik, 2008), where policy ideally has the quality of 'embedded autonomy'. It is not captured by firms and sectors, but focuses on the discovery process, where firms and the state learn about underlying costs and opportunities and engage in strategic coordination. In the context of re-shoring possibilities for UK manufacturing, for example, it might mean government working with industry to identify key fractures and gaps in the supply chain and how to address them. In this regard, there is an institutional and capacity failure inherent at the national level in terms of the lack of policy conviction and a lack of resources to design pro-manufacturing industrial policy interventions.

6.0 Brexit and the New Industrial Strategy

6.1 Brexit: The Elephant in the Room?

The future role and potential efficacy of UK industrial policy needs to be considered in the wider context of the country's June 2016 referendum decision to exit the European Union (or 'Brexit' as it is commonly referred to). As yet, full details of the UK's future relationship with the EU are unclear though the Prime Minister has indicated the UK is likely to leave both the Single Market and the Customs Union to maintain controls on immigration and pursue its own bilateral trade deals (Financial Times, 8/1/2017). While 'special (tailored) trade deals' with the USA and other countries (e.g. India) have been touted, none of these can be negotiated (and agreed) until the UK is formally out of the EU and being the smaller partner in such negotiations, the UK is unlikely to be able to secure favourable access to these other markets.[11] As economists' gravity models have long demonstrated, the reality is Europe will remain the UK's most important market(s) (there will just be less trade), and the failure to reach a satisfactory deal with the EU means the UK risks leaving the Bloc reliant upon the myriad complexities of World Trade Organisation (WTO) rules (Dunt, 2016).

This so-called 'Hard Brexit' is likely to have serious implications for UK business, trade and investment, particularly in industries such as automotive and aerospace, where complex supply chains are fully embedded within the Single market (with components criss-crossing between

[11] Indeed, concerns have been raised that any deal with the USA is likely to be detrimental to UK interests. Tariffs are already low between the countries, and any deal is likely to give greater opportunities to US corporations to manipulate and expropriate contracts in UK public services, including the NHS (Independent, 17/1/17).

the UK and other EU borders several times) and which rely upon free-trade to operate efficiently. A 'Hard Brexit' threatens to severely disrupt these supply chains, with high tariffs (in the case of automotive engines, rising to 10%) and a plethora of non-tariff barriers for British exporters to contend with. In turn, reduced trade threatens to significantly hamper inward Foreign Direct Investment into the UK since the loss of free access to the single market makes the country less attractive to foreign investors (Driffield and Karolglou, 2016; Dhinga et.al., 2015). This would be a major blow to the UK's existing manufacturing base, which - ironically - is most likely to be felt in regions outside London that predominantly voted to leave the EU and disproportionately suffered from the GFC (and before that the impact of globalisation and de-industrialisation in the 1980s and 1990s) (Los et al., 2017). Many of these are lagging regions, and are proportionately more reliant upon EU structural funds for regeneration, which will no longer be forthcoming. There is also uncertainty as to whether the UK will remain part of the European Research Area (ERA), and be able to participate in and access funding through programmes such as Horizon 2020 (and also Erasmus for student exchange). Leaving the ERA will make the UK less attractive for international scientists and researchers, and will ultimately undermine the UK's strategies for innovation and smart specialisation.

There remains much ambiguity, confusion and uncertainty on how things will play out. For instance, in late 2016, the UK government reached a 'deal' with Nissan over investment at its Sunderland plant to produce the Nissan Qashqai and XTrail models from 2020 onwards (by which time the UK will have left the EU). This 'deal' is shrouded in secrecy as it is not clear what the government offered Nissan and, moreover, what does it tell us about the government's new industrial strategy and (more broadly) its negotiating stance on Brexit? On this we have learned a little from the new Business Secretary, who has made it clear that a key UK objective in Brexit talks will be to avoid tariff barriers with the EU. He also repeatedly made reference to industry sectors and their different needs, implying that the UK would seek to negotiate sector-by-sector deals with the EU. That could see the UK trying to avoid non-tariff barriers in certain sectors like automotive, effectively giving those sectors something akin to access to the Single Market (The Guardian, 30/11/16). While realising such deals will depend upon the agreement of the EU – and that might be difficult across 27 nations (and Wallonia Parliaments!)

– it at least suggests, that new the Business secretary views access to the EU Single Market as a key negotiating objective.[12]

The Business Secretary's comments raise a number of points on Brexit on which the government has been vague so far. First, the Business Secretary seemed to imply that – as a minimum - the UK could remain in a customs union with the EU. This would go a long way to reassuring the automotive industry on tariffs. Secondly, if the UK really does want to trade without tariffs and non-tariff barriers, then the EU may well extract a 'price' in the form of a contribution to the EU budget, as made by Norway and Switzerland (Dunt, 2016). Thirdly, some form of 'referee' may be needed to determine whether the UK is playing by the rules of whatever trade deal is done with the EU. This might be the WTO or a body linked to the EU. Fourth, despite Nissan wanting 'compensation' if tariffs are imposed, Clark appeared to suggest that may not be possible under WTO rules.

6.2 The New Industrial Strategy

It is beyond the scope of this chapter to deliberate much further on the wide-ranging impacts of Brexit; for a fuller discussion of these issues, see Bailey and Budd (2017). Nevertheless, in the context of industrial policy, it is clear that Britain needs to strike more than a new trade deal with the EU (Bailey and De Propris, 2017). The government appear to partially recognise this and, indeed, on 23rd January 2017 launched a green paper entitled 'Building our Industrial Strategy'. The green paper prioritises ten pillars to drive forward the government's industrial strategy. These are: (i) investment in science, research and innovation; (ii) developing skills; (iii) upgrading infrastructure; (iv) business support; (v) procurement; (vi) trade and investment; (vii) affordable energy (and clean growth); (viii) cultivating world-leading sectors; (ix) balanced growth (across the country); and (x) aligning sectors and places. Focusing on these pillars is a laudable objective, though much of the green paper does appear to re-iterate measures that are already being pursued across several government departments.

Nevertheless, the tone of the document seems to represent a shift in the Conservative government's thinking on industrial strategy, with a more interventionist stance (in some quarters at least) now being openly advocated. The green paper also pledges an additional £4.7 billion of government money (by 2020-21) for R&D funding – the largest increase in any

[12] Whether the International Trade Secretary, and/or the Brexit Secretary, agree with this position is another matter.

Parliament since 1979 – in an effort to raise the chronic gap between UK R&D funding vis-à-vis those in other G7 countries (see section 3). This accompanies government plans to boost STEM (science, technology, engineering and mathematics) skills, digital skills and numeracy, including extending specialist mathematics schools, with £170m to be invested in creating new 'institutes of technology'. The green paper also re-iterates the importance of infrastructure (including broadband and digital) to support balanced growth; investment here will rise from £14 billion in 2016/17 to £22 billion in 2020/21. This should be put into context, as this 'new money' is partly a reversal of the unprecedented substantive cuts in UK infrastructure spending during the austerity budgets of the Conservative led Coalition government; between 2009-2010 and 2013/14, public sector net investment was cut by 42% in real terms, falling from 3.4% to just 1.8% of GDP (Independent, 29/9/2016). At least, there is now some acknowledgement within (parts of) government that public investment can 'crowd in' private sector investment, which in turn generates growth (Crafts, 2009).[13]

There are, however, several notable weaknesses in the green paper.[14] From the outset, the paper appears to have an outdated view of manufacturing, and makes no reference to recent developments surrounding Industry 4.0. This is a new manufacturing paradigm, based around firms utilising the latest digital, cyber and information technologies to re-organise manufacturing within so-called 'smart factories', alongside a closer alignment of services (including design and post-sale services) and customised products (commonly referred to as 'servitization'). These trends are likely to place a greater emphasis upon small batch and local production, which will not only reduce environmental footprints but also offer an opportunity for a re-coupling of manufacturing and innovation (Bailey and De Propris, 2014). Related to this is the R&D pillar is very 'sector focused' and largely fails to identify the higher level and enabling technologies (such as robotics and artificial intelligence) that cut across sectors (and places). In this regard, the UK's industrial strategy needs to be more ambitious in setting out a roadmap for how existing sectors (and places) can be transformed by these enabling technologies over the next ten to twenty years. There also needs to be a greater appreciation of the spatial and systemic aspects of R&D; the private sector is currently underinvesting as risks are not being shared by the government and other public institutions (such as universities) (see section 2).

[13] Most recently the 2017 Budget committed £270m to supporting a range of disruptive technologies including driverless cars and battery technology (HMT, 2017).

[14] We are grateful for discussions with Lisa De Propris, Philip McCann and Paul Hildreth in relation to the points below in this sub-section.

In addition, the text of the green paper (and especially in the dedicated tenth pillar) lacks a truly spatial dimension and the long standing disconnect - in UK policy circles - between sectors and places appears to remain. The Coalition's abolition of RDAs – which had a broader coverage of industrial clusters - and their replacement with LEPs led to a fragmentation of policy and resources, with many LEPs being too narrowly focused and lacking the capacity to be effective in implementing the new industrial strategy, especially in relation to developing clusters and supply chains (Pike et al., 2015). As research in the field of regional studies has long demonstrated, appropriate institutions are key to aligning sectors with regions and places, and in this regard, an effective regional institutional framework is essential to delivering balanced across the UK. Without such a regional framework, there is the risk that growth will remain concentrated in a few areas of the UK (Hildreth and Bailey, 2013). Development bodies – at the regional tier – have the capacity (and information sets) to intervene more widely and strategically, to pursue 'smart specialisation' strategies which cut across sectors in a place-based approach (see section 4). Combined Authorities may be one way to achieve this, perhaps with so-called city-regions evolving; this is an area in which the current Business secretary has some expertise. In this regard, competitive public funding might be awarded using a model structured around regional coalitions, which would help to build capacity at the regional level and, in particular, encourage applications from across the country so as to ensure such funding is not concentrated in leading regions which appear to have the best projects (see section 4). Indeed, the green paper is silent on regenerating formerly industrial areas, and might have been more explicit on how to revitalise these 'left behind' regions.

More widely, the green paper largely fails to link themes such as R&D, supply chain development and skills in a place-based institutional approach. With regard to skills, there is currently too great an emphasis on national accreditation, and here the devolution of skills and funding would be a welcome step forward. Local areas and regions need to be able to shape training programmes in line with spatially-specific needs and aspirations, as in the case of the new Ceramics Skills Academy in Stoke on Trent (Tomlinson and Branston, 2014). A related issue is the green paper appears to treat supply chains and clusters as separate entities; in reality, both are entwined and again would benefit from policies geared towards re-building skills and revitalising local and regional (knowledge) networks. Similarly, trade and investment would benefit from being devolved to a regional tier; the Department for Trade is heavily centralised, and like its predecessor –UK Trade and Investment (UKTI) – largely ineffective in dealing

with vital issues such as developing UK supply chains. The risk of continuing with the status quo is that investment and growth will remain concentrated in London and the South East.

7. Concluding Comments

Over the last decade, there has been a revival of interest in industrial policy within the UK, largely as a consequence of the fallout from the GFC and rising dissatisfaction with the dominant neo-liberal model. Modern industrial policy is no longer about 'picking winners', but is smart and largely based around technology and enhancing innovation across sectors and places. In these spheres, there are inherent market failures and there is a strong case for state intervention (Bailey, et al., 2015). However, despite the recent Industrial strategy green paper and some promising early industrial policy initiatives, such as the Automotive Council and the Catapults, there remains much ambivalence about the UK government's industrial policy. In some aspects, particularly with regards to R&D, skills and promoting balanced regional development, the government's stance on industrial policy has been at best 'muddled' and at worst, been 'empty rhetoric'. Indeed, as indicated in the Introduction to this chapter, the UK's performance in manufacturing – on almost every measure – is worse than before the GFC and the sector lags significantly behind its international rivals. Given much of UK manufacturing is – through its complex supply chains – closely integrated with continental Europe, the shadow of Brexit is the proverbial 'elephant in the room' with regards to the future course and efficacy of UK industrial policy.

In the short term, the recent depreciation in sterling potentially opens up an opportunity for a re-shoring of some manufacturing operations; for example, in the automotive supply chain. However, this will not happen automatically, since are significant barriers to re-shoring notably a lack of access to finance among UK SMEs, skills deficiencies, availability of land and high energy costs (see Bailey and De Propris, 2014). Focusing on these issues, and developing UK supply chains might bring some medium to long term benefits; indeed, there seems to be some recent government commitment in this regard, particularly in the automotive industry which largely sources (high value) components from continental Europe (HMG, 2017). Related to this, the government could seek to reduce Brexit-induced uncertainty, by stimulating manufacturing investment through instruments such as enhanced capital allowances and by resurrecting something like the Advanced Manufacturing Supply Chain Initiative (preferably on a much wider scale), along with plugging funding gaps for small firms in the supply chain.

Finally, and at a broader level, there is now a strong case, for UK industrial policy to be afforded similar institutional status to both UK monetary policy, which, since 1997, is managed through an independent Bank of England, and fiscal policy, which is monitored by the Office for Fiscal Responsibility (established in 2010). As we have set out in this chapter, an active industrial policy not only creates and sustain domestic employment (thus sustaining demand (via investment and consumption multipliers)), but it can also raise domestic industrial capacity and capabilities (a supply side measure) for innovation and long term growth in a balanced, inclusive and sustainable way. At the very least, it should be the subject of regular strategic long-term reviews as the Wright Review (2014) has suggested. By giving it that sort of priority, the government would send out the kind of powerful message that British industry and foreign investors need to hear. This is will especially important as the UK economy charters new waters in the post-Brexit era.

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Catapult Centre	Main Location(s)	Remit	Major Projects *(as at end of 2016)*	Website
Cell and Gene Therapy	Guy's Hospital, London	Translates early stage research into commercially viable and investable therapies.	In 2015/16, engaged with 36 research partners and 22 new projects 13 clinical trial sites across UK Partner in £27.3 million of collaborative R&D grants between 2014-16 £21.3 million invested in gene and cell therapy projects between 2014-16 New GMP manufacturing facility in Stevenage (due in 2017)	https://ct.catapult.org.uk/
Compound Semiconductor Applications	Cardiff	Provision of translational research facilities to accelerate the commercialisation of compound semiconductors in key application areas *(including healthcare, the digital economy, energy, transport, defence and security, and space).*	Opening in 2017 The catapult will receive £10 million per annum in government funding until 2020-21	https://goo.gl/THZ0aM
Digital	Kings Cross, London	Applied R&D focusing upon opening up new markets (for firms) in new and emerging digital technologies.	Launched a number of projects including; Things Connected, Smart Contracts for IP Assembly, Cyber 101, Internet of Things UK (OTUK), Greater Manchester Data Synchronization Project, Trusted Data Accelerator, Open Health Data Platform, Digital Copyright Exchange; 5G Demonstrator	https://digital.catapult.org.uk/
Energy Systems	Birmingham	Transformation of whole energy system and development of new technology-based energy based products & services for commercialisation *(covering electricity, heat and combustible gases).*	Several major projects including responsibility for the delivery of the Energy Technologies Institute's (ETI) Smart Systems and Heat programme and the Future Power System Architecture Project.	https://es.catapult.org.uk/
Future Cities	Borough, London	Assisting UK firms create integrated products and services to advance urban innovation and meet the future needs of the world's cities.	Involved in several major projects including the Cities Standards Conformity Assessment (CiSCA), Cities Unlocked, Urban Mobility Innovation index, Things Connected, Future of Planning, Global Review of Smart City Strategies, Iskandar Innovative Sustainable Transport Solutions.	http://futurecities.catapult.org.uk/

High Value Manufacturing *(7 Centres: Advanced Forming Research Centre (AFRC), Advanced Manufacturing Research Centre (AMRC), Centre for Process Innovation (CPI), Manufacturing Technology Centre (MTC), National Composites Centre (NCC), Nuclear AMRC, WMG Catapult)*	Ansty (MTC) Bristol *(NCC),* Coventry *(WMG),* Rotherham *(AMRC & NAMRC)* Strathclyde *(AFRC),* Warwick *(WMG).* Wilton/Sedgefield *(CPI)*	Catalyst for growth and success of UK advanced manufacturing. Assisting firms to turn ideas into commercial applications by addressing the gap between technology concept and commercialisation.	In 2015/16, HVM had 3,036 clients and was involved in 1,878 projects with the private sector. In addition, 39% of the catapult's innovation activities came from industry. During 2015/16, the catapult generated £188 million of sales and it's total assets were valued at £561million, with £74.5 million investment in large capital projects. It employed 1,913 engineers, technicians and support staff. It is estimated that every £1 of core funding generates £15 of benefits to the wider UK economy.	https://hvm.catapult.org.uk/
Medicines Discovery	Alderley Edge, Cheshire	Development of new technologies primarily for the preclinical evaluation of medicines	Launched in April 2016	https://md.catapult.org.uk/
Offshore Renewable Energy	Glasgow	Facilitates the development and commercialisation of innovative and technological solutions in wind, wave and tidal energy	Major projects include the development of a marine farm accelerator (MFA), (offshore energy) cost reduction monitoring framework, CLOWT, Wave Energy Scotland.	https://ore.catapult.org.uk/
Precision Medicine	Cambridge	Development and practice of precision (personalised) medicine for patients, life sciences and industry.	Major projects include Cytosponge detection of oesophagus disease, FeNO test for asthma and chronic pulmonary disease, X-Lab's iCARE and NETMIS software modelling pathways.	https://pm.catapult.org.uk/
Satellite Applications	Harwell, Oxfordshire	Development of satellite systems and services to assist firms in realising the potential from space.	Currently focused upon 5 market led programmes which cumulatively have global growth potential of £60 billion over the next decade. These are Intelligent Transport Systems, Blue (marine) economy, Sustainable living, Explore (utilising space related technology into wider economy) and Government services (using satellite technology to enhance public services) .	https://sa.catapult.org.uk/
Transport Systems	Milton Keynes	Development of smart, connected transport systems (and intelligent mobility solutions) for the UK economy	Major projects include Driverless pods, rail franchising, departure planning information, Manchester Smart Table, Sentiment mapping, Traveller Needs and UK Capability Study, Visualisation Laboratory.	https://ts.catapult.org.uk/

Table (1) The UK's Catapults 2017

See also Hepburn & Wolfe (2015)