This is the peer reviewed version of the following article: Hannon, Enda (2016) Industrial policy and employment in the UK : evidence from the pharmaceutical sector. Industrial Relations Journal, 47(1), pp. 2-20., which has been published in final form at https://dx.doi.org/10.1111/irj.12120. This article may be used for non-commercial purposes in accordance with Wiley Terms and Conditions for Use of Self-Archived Versions.

Introduction

British employment scholars have long identified the existence of a skills problem in the UK. The 'matched plant' studies undertaken by the National Institute for Social and Economic Research in the 1980s and 1990s identified how productivity levels in British firms were significantly lower than in comparator firms in Europe, with the quality of products manufactured also comparing unfavourably. A central finding was that these gaps and weaknesses were attributable to the inferior intermediate and technical qualification and skill profiles at the British firms (Daly *et al* 1985; Steedman and Wagner 1987, Mason et al 1994).

A similar pattern of weak qualification and skills profiles alongside low quality good and services was identified across the economy as a whole (Finegold and Soskice 1988; Glynn and Gospel 1993; Keep and Mayhew 1999). This was seen to be attributable to systemic weaknesses, the mutual interaction of various problematic features of the British economy including the short-term investment horizons resulting from the nature of corporate ownership patterns and financial market operation; the weakness of general management skills; the flexible/lightly regulated nature of the labour market; and weak central employer and trade union organisations and systems of worker representation (Finegold and Soskice 1988; Glynn and Gospel 1993; Keep and Mayhew 1999; Mayhew 2013).

It is now better recognised that the British economy possesses a number of internationally competitive, quality focused and high-skill sectors such as aerospace. However while employment levels are at a record high, in general terms the UK economy continues to suffer from serious weaknesses. The important manufacturing sector has witnessed a dramatic decline; productivity levels continue to lag significantly behind countries such as Germany and France; intermediate level skills are lacking; and there are serious problems of

low pay, pay inequality and under employment (Lloyd and Mayhew 2010; Wright 2014; HM Treasury 2015; TUC 2015).

In addition to systemic weaknesses, the dominance of 'laissez-faire' principles and consequent government reluctance to proactively shape the strategic performance and direction of British industry has historically been identified as problematic (Finegold and Soskice 1988). While the UK government has become more hands-on over time, policy has been characterised by a dominant focus on measures aimed at improving the supply of skills (Lloyd and Mayhew 2010). It is argued that an active industrial policy comprising policies and measures that support firms and sectors to innovate, compete on the basis of high quality and become more productive; could more effectively underpin improvements in job quality and skills utilization (Finegold and Soskice 1988; Keep and Mayhew 1999; Brown et al 2015).

However as Lloyd and Payne (2002: 375-6) note, while many authors have highlighted the potential of an industrial policy to enable the UK to move to a higher skills path, with some exceptions they have typically not elaborated in detail on what such a policy might look like or how it would work. There is therefore a need for research of this nature. This is accentuated by the fact that industrial policy has become more prominent as a result of the financial crisis and recession, with national governments undertaking various efforts to alleviate the crisis and promote growth via support for particular industries and regions (Clift and Woll 2012). Notably, there have been significant developments in this regard in the UK, with the adoption of an active industrial strategy announced by the Conservative-Liberal coalition in 2012 centred on the development of close partnerships with strategic sectors (BIS 2012; Cable 2012).

This paper aims to contribute to academic understanding of the significance of industrial policy for employment and skills, by examining the nature of UK government industrial policy *vis a vis* the pharmaceutical sector and the performance and employment implications of the same. In contrast to the general picture, pharmaceuticals has historically benefited from significant government support, and examining developments in that sector may therefore shed light on the employment consequences of an active industrial policy.

The paper first outlines the economic and political dimensions and tangible forms of industrial policy, before discussing its general impact on employment. Previous research on industrial policy and employment is then considered. Next the research methods and sectoral context are outlined, before the main findings from the UK pharmaceutical sector are presented. Finally, a discussion and conclusion are provided.

Industrial Policy

Key Features

Following Johhson (1984:8) we define industrial policy as involving 'the initiation and co-ordination of governmental initiatives to leverage upward the productivity and competitiveness of the whole economy and of particular industries in it.' Economists outline how industrial policy may be 'horizontal' or 'selective' (also labeled 'vertical') in nature (Chang 1994; Crafts 2012; Mayhew 2013). Horizontal policies apply across all organizations, for example tax incentives or regulatory requirements. Selective policies are applied to particular industries or firms, for example state investment in renewable energy.

A primary motivation for the introduction of industrial policies commonly outlined in the literature is to correct market failures (Chang 1994; Crafts 2012; Mayhew 2013). For example governments may invest in particular technologies or industries that will generate

revenue in the long term where capital markets refuse to do so given the lengthy timeframe before revenue generation. A second important rationale for industrial policy measures is to reap the benefits arising from 'positive externalities.' An example here is incentivizing firm-level investment in R&D: this generates benefits for the wider economy beyond the individual firm and hence it is in the public interest to promote it.

The emergence of 'new institutionalist' and technology centred theories of economic growth has led to an increasing acceptance of the role of industrial policy over recent decades (Chang 1994). These emphasise how public institutions and regulation support the development and functioning of markets, with state investment in new technology essential in overcoming the market failures highlighted above (Chang 1994; Rodrik 2008). Developments in the related fields of innovation studies and economic geography similarly emphasise the value of industrial policy in the contemporary economy, highlighting the importance of state investment in research and other 'factor conditions' as well as the centrality of clusters and networks underpinned by public institutions (Cooke and Morgan 1998; Etzkowitz and Leydesdorff 2000; Lundvall 2007).

Measures and Instruments

Historically it was common for governments to intervene directly in product markets, for example by restricting imports of particular products to support indigenous firms or establishing state monopolies in certain activities. However globalisation, the growing importance of knowledge-based activity for economic development, and multilateral trade agreements emerging from the World Trade Organisation, have led to significant change in the general orientation of industrial policy and the particular instruments and tools utilised by policymakers over recent decades (Bianchi and Labory 2006; Weiss 2010).

Table 1 below outlines ten key general industrial policy activities together with associated examples of what these involve identified from the industrial policy literature (e.g. Porter 1990; Bianchi and Labory 2006; Huggins and Izushi 2007; Bloch 2008; Weiss 2010).

<< insert table 1 about here>>

While deregulation and the enhancement of product market competition are included in the table, the other more positive and proactive measures outlined are necessary to move economies into higher value market niches (Porter and Ketels 2003). Alongside the existence of pertinent measures, the literature highlights how the state's management of industrial policy is important, with the need for governments to ensure coherence between measures, policies and decision-making levels as well as to continually adapt and refine policies emphasised (Bianchi and Labory 2006; Huggins and Izushi 2007).

The Political and Contested Nature of Industrial Policy

Historically there has been fundamental disagreement among academics, policymakers and politicians regarding the role and effectiveness of industrial policy. Those with a neoliberal perspective have taken the view that industrial policy is fundamentally ineffective, that governments are not capable of successfully directing and allocating resources to industry and may be subject to 'capture' by particular interest groups. This perspective argues that government's primary role is to ensure the free operation of markets and conditions enabling private enterprise and individual initiative to flourish (Chang 1994; Weiss 2010).

In contrast, those favouring social democratic perspectives and emphasising the importance of institutions and agency, have argued that the state has a central role to play in directing

economic activity and promoting growth and development, and that it is capable of doing so (Rueschemeyer and Evans 1985; Chang 1994; Weiss 2010).

The political and contested nature of industrial policy has been very apparent in the UK. While during the 50s, 60s and 70s there was some significant support for active industrial policies, the election of the Thatcher led Conservative government in 1979 led to a decisive shift to a predominantly neo-liberal approach, centred on ideological commitment to the free operation of market forces. This led to a marked reduction in industrial policy initiatives and expenditure (Grant 1982; Coates 2000). As noted above, critics have identified this shift in government policy as contributing to serious weakness in industrial and wider economic performance in the UK, consequently negatively impacting both the quality and quantity of employment. They have called for the adoption of an active industrial policy to address these weaknesses (Finegold and Soskice 1988; Delbridge and Lowe 1998; Coffey and Thornley 2009).

Industrial Policy and Employment

Establishing the impact of industrial policy measures given the presence of various other parallel influences is challenging and the subject of much debate (Greene, Mole and Storey 2008). Whilst acknowledging this, it is evident that industrial policy can, at a fundamental level, greatly influence business creation, survival and success; with important consequences for employment, work organization and skills within particular companies or sectors (Stiglitz and Lin 2013). Industrial policy can, via its influence on firm strategies and performance, be seen as a 'first order' determinant of employment and skills outcomes (Purcell 1989).

Related interventions may affect the quantity and quality of employment, with the creation of high-wage, high-skill jobs typically a primary objective (Warwick 2013). Selective industrial

policy interventions may be 'defensive/reactive' or 'strategic' in nature. The former aim to protect or upgrade existing activities and jobs. In contrast, the latter are focused on the development of new activities or capabilities, resulting in the creation of new jobs (Warwick 2013: 29).

British skills researchers have examined the economic and industrial policies adopted by the 'East Asian Tiger' economies Singapore, South Korea and Taiwan (Green et al 1999; Green and Sakamoto 2001). This research, drawing on interviews with policymakers, employers and expert observers in addition to secondary data, highlights how the governments of these countries have taken interventionist and closely coordinated measures over decades to promote economic development. This has involved targeting and support for particular activities or industries; high levels of public investment in infrastructure, manufacturing capacity and R & D; the introduction of financial incentives for foreign direct investment; legal instruments mandating staff training; and the systematic matching of skills supply to industry demand. This has underpinned strong growth and a progressive transition to higher value activities in these countries, as well as dramatic increases in qualification and skill levels over time (Green et al 1999; Green and Sakamoto 2001).

Hannon et al (2011) outline how active industrial policy has been similarly central to the Irish pharmaceutical sector's strong growth and the creation of a large number of high-wage, high-skill jobs there. Qualitative case studies highlight how individual firms have undertaken new investments in higher value, knowledge-intensive activities such as biopharmaceuticals, in response to strategic initiatives on the part of the Irish government and associated support measures relating to finance, R & D, skills and training. These have underpinned expansions of employment at graduate level and above.

Research methods

This paper examines the nature of UK government industrial policy in the pharmaceutical sector and the employment implications of the same. We draw on eleven interviews with policy makers and industry officials conducted in 2008-09. These were used to obtain information on the various policies and programmes of relevance to the sector adopted by government and public agencies, and industry officials' views regarding their impact and effectiveness.

In addition, seventy two interviews were conducted at five pharmaceutical companies during 2009, comprising four multinationals and one small university spin-out (see table 2). Interviews lasting between 45 minutes and an hour were undertaken with general, HR and training managers as well as line managers, scientists and other operational staff. Management interviews identified the nature of firm strategies and the extent and impact of external interactions and the wider policy context. Interviewees with scientists and other operational staff addressed perceptions of job satisfaction and views about working in the British sector. Interviews were recorded and transcribed where possible.

While the views and perceptions of operational staff are of great importance (Hannon et al 2011), due to space restrictions here we focus on data from the management interviews. These are supplemented by secondary data on relevant themes including previous academic research; official statistics; government, state agency and industry body documents and reports; periodicals and other news sources.

In examining the employment effects of industrial policy we focus on three key objective aspects: trends in numbers employed, wage levels and skill levels (as measured by

qualification profiles). Additional industry performance data is included to enable a holistic assessment of trends in the sector.

<< insert table 2 about here>>

The pharmaceutical sector

Pharmaceuticals is frequently identified as an important 'knowledge economy' sector, being characterised by high relative wage and skill levels (e.g. Brinkley 2008). It has historically focused on the development of 'small molecule' chemical compounds that affect particular targets or processes in the human body (van Egeraat and Barry 2008). Product development in the sector is distinctive for its lengthy, complex and costly nature and has consequently been dominated by large multinationals from the US, Western Europe and Japan (Achilladelis and Antonakis 2001).

Since the 1980s pharmaceutical companies have come under strong competitive and operational pressure due to a decline in the rate of successful new drug development; shorter effective patent life due to lengthier development and approval processes; increased competition from manufacturers of generic drugs; and downward pressure on margins exerted by cost-conscious national governments (Froud et al. 1998). The progressive development of the medical biotechnology or biopharmaceutical sector has also challenged existing firms and operating models. The latter is centred on the use of large molecules derived from living organisms as active ingredients instead of chemically based small molecules, with SMEs at the forefront of innovation (Ernst and Young 2010).

These trends and pressures have prompted very significant rationalization within the world industry, involving various acquisitions and mergers between firms as well as cost-cutting

within individual businesses (Froud et al. 1998). A prominent, related trend in the last decade has been the enormous growth in outsourcing of activities such as molecule screening or later stage clinical research. There is also a move among the leading firms to target investments in fundamental research to emerging countries such as China and India who are producing large numbers of science graduates (Ernst and Young 2010).

Industrial Policy and the UK Pharmaceutical sector

Various aspects of the national policy and institutional context historically promoted the development of the UK pharmaceutical sector, including the favourable rules of the UK's pricing system for pharmaceutical products; a responsive product safety regime involving strong industry input alongside academic expertise; the expansion of the National Health Service; very strong public science base; and the government's strategic attraction of foreign direct investment of an innovative nature (Hancher 1990; Thomas 1994; Abraham 2009; Owen 2010). Concern on the part of government to assist the industry and deference to its interests and demands have frequently been evident (Hancher 1990; Abraham 2009).

Over the last 10-15 years state industrial policy towards the sector has become progressively more explicit and active. The Labour government established the Pharmaceutical Industry Competitive Taskforce in 2000 to examine the competitive position of the industry (PICTF 2001). This led to the establishment of the Ministerial Industry Strategy Group, which meets twice a year bringing together industry and government representatives to discuss key issues affecting the sector.

The industry benefited from the substantial increase in government science funding from 2004 and the concerted drive to ensure that research councils such as the Medical Research Council collaborated more closely with industry and undertake research of benefit to the

latter (interviews). In 2009 the government set up the Office for Life Sciences as a cross departmental body with the task of promoting the competitiveness of the UK life sciences sector. Various working groups comprising representatives from government, industry and academia were formed, which led to the development of an overarching 'blueprint' document in 2009 and subsequent progress report in 2010 (OLS 2010).

The policies of the Conservative-Liberal government 2010-2015 built closely on those of its predecessor. An express policy of protecting the science budget was adopted. A *Strategy for UK Life Sciences* was set out in December 2011, which outlined the objective that the UK would 'become the global hub for life sciences' (BIS/OLS 2011: 6). The strategy contained thirty-one specific actions to be implemented, with progress and additional initiatives outlined in a report published in December 2012 (HM Government 2012). A dedicated Minister for Life Sciences was appointed in 2014 with further significant investment initiatives announced (HM Treasury/BIS 2014). Whilst reportedly reviewing and questioning the general merits of industrial policy (Financial Times, June 8th 2015), the Conservative government elected in May 2015 has continued to provide dedicated support to pharmaceuticals. Table 3 summarises key initiatives resulting from the OLS, *Strategy for Life Sciences* and subsequent policy development aimed at strengthening the sector.

<<insert table 3 about here>>

The table outlines a large number of significant initiatives in support of the UK pharmaceutical industry, comparable in nature and in some ways more resource intensive than in comparator countries such as France (BMI 2015; HM Government 2015b).

The perceived importance of the sector and related employment came sharply to the fore in Spring 2014 when the US multinational Pfizer attempted to acquire the British firm AstraZeneca. The attempted takeover, which was ultimately unsuccessful, was met with outrage and scepticism on the part of politicians and industry figures due to fears about its implications for jobs and the wider position of UK science (House of Commons 2014).

Next we consider the impact of these measures and the broader industrial policy context for performance and employment in the sector, drawing on the policy related interviews and in particular the case studies of the five firms. Key issues and themes identified are addressed in turn.

The institutional and policy contexts, firm strategies and innovation

Access to skills

For the large firms P1, P2, P3 and P4, the ability to recruit large numbers of high quality graduates and research scientists from pharmaceutical or medical related disciplines had historically been a key strength of the British context, with managers highlighting the enormous capabilities and expertise of their staff. This situation had changed however and in the words of a senior manager at P1 was now "more on a knife-edge."

These firms reported skill shortages in important traditional areas such as clinical pharmacology, toxicology and *in vivo* sciences, as well as newer areas such as biochemistry and computational statistics. Interviewees noted how the school curriculum meant that graduates frequently lacked adequate mathematical skills, while many university science qualifications did not provide graduates with essential knowledge and practical training in key disciplinary subjects. A senior manager at P5 made similar observations and noted how he was having great difficultly recruiting a laboratory technician who could do *in-vivo* work.

In order to address these gaps, the large firms were in close contact with government both directly and via the Association of British Pharmaceutical Industries (ABPI). While interviewees spoke positively of interaction with government about the school curriculum, they were more critical about developments in higher education. While HEFCE, the Higher Education Funding Council for England, had provided additional funding enabling more students to be recruited onto chemistry and physics degrees, support for bioscience courses was lacking (ABPI 2008). The funding of laboratory based disciplines was seen to be inadequate and there was a perceived need for stronger efforts on the part of HEFCE and the university sector to address the industry's skills requirements (ABPI 2008).

P1, P3 and P4 did obtain some funding from higher education authorities and research councils to provide dedicated resources for the development of *in-vivo* skills at four universities. A senior manager noted at P3 how this had been an example of proactive 'industrial activism' on the part of the firms, but lamented the small amount of resources involved (£12 million). In July 2014, the government awarded £32 million for the establishment of an employer-led 'Science Industry Partnership' with the purpose of helping science employers address skills gaps. This dedicated skills organization, in which life science companies play a central role, has subsequently set up an industry degree scheme focusing on employability and Masters in Formulation Science and Technology, among other initiatives.

The multinational status of the large firms was pertinent in relation to skills. Much lower level R&D activities such as molecule screening had long been moved to lower cost international locations. There was also evidence of a trend towards the transfer of higher value activities. P3 had for example recently opened an R&D centre in China, where according to a senior recruitment manager there was a 'great skills set.'

Access to Knowledge and Research Collaborations

Each of the large firms P1, P2, P3 and P4 had close research links with UK universities, with strong relationships also with clinical organisations, research councils and health research charities. This involved contact with individual researchers at particular institutions as well as larger collaborative projects involving other firms and organisations. The small firm P5 was itself a university spin-out and had very close links with a number of UK universities regarding product development.

The extent of external interactions undertaken by P3 was striking. The following quote from a senior manager gives a sense of this:

> If you name a university I'll tell you what we've got there. There are lots of links throughout the whole company in various guises……each of our R & D business units have strategic plans and within that there will be an external component that's been up front and thought about.

The manager explained that the company's objective of increasing its throughput of chemical entities was necessitating an expansion in external contacts and collaborations. In this regard, P3 had recently signed an extensive collaboration agreement with a large health charity involving the sharing of research targets. P4 engaged in comparable collaborations and had a similarly large number of external contacts with UK universities and research institutions.

While noting that expertise in particular areas was narrowly distributed, interviewees at all five firms highlighted the strength of the pharmaceutical and medical related research being

undertaken in the UK and noted how this constituted a significant resource and source of competitive advantage. A policy manager at P2 explained how that company's UK research site had been chosen as the location for a strategic new investment in the neuroscience area due to the strength of UK research. P1, P3 and P4 were involved in a large collaborative project with a British university. A senior manager at P3 described the particular knowledge base there as 'second to none in the world', and explained how that company undertook various projects with the university that were of substantial strategic benefit.

Support for Innovation in the Market Place

The lack of investment finance in the UK sector was identified as problematic by industry officials as well as by a senior manager at P5 the recent start-up. This was seen to place a substantial constraint on the translation of discoveries into marketable products and hence the development of the biomedical/biopharma sector. While there has been a recent notable improvement, the UK continues to lag far behind the US in this regard (BIA 2015).

The case study firms had regular contact with the Technology Strategy Board (now Innovate UK), the state agency with the role of promoting business innovation. The MNCs P1 and P3 and small firm P5 had all recently received substantial funding from the TSB under its collaborative research competition programme alongside other firms and research institutions. Awards for individual projects were over a million pounds and supported product or process development. For P1 and P3 these awards were seen to be valuable, with the fact that they enabled additional funding to be leveraged from other parties involved being particularly useful.

For P5 funding from the TSB had been crucial to the survival of the business against the context of the serious lack of investment finance. According to a senior manager, recently

winning a TSB grant had been an 'absolute lifeline', which allowed the company's research programme to be progressed more quickly. In addition, on the strength of the TSB award the company had been able to raise additional funds from existing investors. Apart from the financial benefit, the expertise and input from TSB officials were seen to be invaluable. Interviewees at the other firms also commended the knowledge and approach of TSB officials.

Regulatory environment

Interviewees were of the view that the Pharmaceutical Price Regulation Scheme (PPRS), negotiated between the industry and government at five yearly intervals, had in general effectively supported investment and innovation in the UK sector. It was noted how express account was taken of expenditure on R&D and other items in deciding on the permitted return on capital for individual firms. The 2012 renegotiation of the PPRS nevertheless attracted some criticism as it introduced a two-year freeze on branded drug expenditure in the NHS.

In contrast, the manner in which the government sponsored National Institute for Clinical Excellence (NICE) undertook health technology assessments of new drugs for the NHS, was seen as a substantial impediment to the introduction of new drugs in the UK. Interviewees at P1 and P2 noted how considerations of economics and cost effectiveness dominated over other social benefits in determining whether a drug should be approved for use in the NHS. A consequence of this was low adoption of new drugs in the NHS compared to countries in Europe and elsewhere.

This was a particular issue for drugs targeting small groups of people as the statistical models adopted by NICE made it extremely difficult to demonstrate cost effectiveness. In

addition, the focus on cost and economic considerations was identified as inhibiting the adoption of effective but expensive end-of-life cancer drugs. It was noted that in France and other European countries medical or social benefits were prioritized and considered separately to cost, thereby promoting take-up of such drugs.

Finally, interviewees at P1 and P4 highlighted the problematic nature of conducting clinical trials within the NHS. The process for later stage trials was so costly and bureaucratic that both organisations were now undertaking these outside of the UK. A manager at P1 explained how the devolved and autonomous nature of decision-making within the NHS had been highly problematic in this regard, with enormous variety in the policies and practices of individual trusts. This interviewee did however note that steps were being taken to streamline and harmonise the process for conducting clinical trials, as outlined in table 2. Combined these weaknesses created sizable disincentives for drug development activities to be located in the UK, with significant existing investment being lost as a consequence.

Financial Incentives & Government Approach

While the government's introduction of R & D tax credits was viewed as valuable and protected current investments, the fiscal environment and financial incentives in the UK were identified as comparing unfavourably with those elsewhere. Interviewees noted how countries such as Ireland and Singapore had very low rates of corporation tax, which meant they were more attractive than the UK as locations for new investment. Interviewees at P1 and P3 explained how new manufacturing facilities had been placed in these countries instead of the UK in order to avail of the more favourable financial incentives. Manufacturing in the UK was therefore contracting while it had grown elsewhere.

Alongside the incentives, the approach of government and development agencies was a significant influence on investment decisions. According to a senior manager at P3, Irish and Singaporean development agencies were 'very, very proactive', going out of their way to facilitate inward investment. In contrast, the UK government was seen to be 'pretty passive towards the pharmaceutical industry.'

While the industrial policy context was therefore seen to be insufficiently effective in incentivizing investment and innovation, the situation was dynamic, with the government attempting to address the issues raised through the Office for Life Sciences and subsequent *Strategy for UK Life Sciences*. As outlined in table 2, the Conservative-Liberal government has progressively reduced corporation tax, with a 'patent box' system also introduced aimed at incentivizing innovation in the UK. Notably, P3 announced a large investment in a new biopharmaceutical plant in the UK, in direct response to the introduction of the patent box system.

Coordination Issues

In addition to weaknesses in discrete areas interviewees highlighted a lack of coordination in policy and approaches towards the sector. The Office for Life Sciences initiative was seen to reflect a change towards a more strategic, integrated approach, with the subsequent Strategy for Life Sciences and various supportive Budget measures illustrating a continued trend in this regard. Nevertheless government policy towards the sector continues to be characterized by a lack coordination and consistency in certain respects, for example between industrial policy objectives and expenditure controls within the NHS. Next we consider the employment outcomes associated with the policy and institutional context.

Employment Outcomes

Levels of employment at the large MNCs P1, P2, P3 and P4 have fallen significantly over recent years. All have implemented redundancy programmes across their R & D workforces. This was particularly marked at P1 and P4 with flagship research centres closed and around 2000 R & D jobs lost at each firm. At the same time however both announced sizable investments in R & D facilities and personnel in a UK region renowned for its strength in the biomedical field.

These reductions in employment are seen to be primarily due to internal company and industry factors, namely the increase in cost of drug development alongside the reduction in throughput of successful new drugs, giving rise to an urgent need to reduce costs and focus R&D efforts. A notable additional well established practice was the outsourcing of activities such as early-stage molecule screening to contract research organisations in lower cost countries as well as the UK.

The decisions to undertake the new investments mentioned were more obviously due to the UK policy context, with the strong biomedical capacities highlighted as key. A more direct effect of the policy context was also apparent in relation to clinical trials at P1, where a small department had been closed with the loss of a number of jobs due to the difficulties experienced in carrying out trials in the UK. In contrast, a policy manager at P2 explained how a new investment in the neuroscience area underpinning 130 research jobs was attributable to the expertise of UK research institutions in this field.

P1, P2 and P3 had also experienced large reductions in their manufacturing workforces. P1 and P2 had recently announced over 2,000 manufacturing redundancies between them, with the closure of a number of factories. The impact of the industrial policy context was

also more prominent here, with new manufacturing investments being made in countries such as Singapore and Ireland instead of the UK due to the more favourable financial incentives offered by the former. Notably however, P3's announcement of new investments in R & D, biopharmaceuticals and manufacturing in the UK in response to the introduction of the 'patent box' was expected to create 1000 new jobs.

The lightly regulated and flexible nature of the UK labour market greatly facilitated these various reductions in R & D and manufacturing employment. P1 and P4 announced the closure of their R & D facilities suddenly without prior consultation with workers or trade unions. Trade union officials were highly critical of this, noting that such sudden announcements of job losses would not be possible in France or Germany due to the stricter regulations there concerning employee consultation and the implementation of redundancies. They highlighted how previous substantial investments in the affected workforces and locations would now be wasted, leading to serious issues regarding skills utilisation. They argued that the UK government should be much more hands-on and proactive in ensuring that the skills of pharmaceutical workers in the UK are used, instead of industry employees being so subject to market fluctuations and business decisions within individual firms.

Employment at the small start-up company P5 had grown somewhat since its foundation, however it still only employed twelve people in total. Prospects for employment growth at this and other biopharmaceutical start-ups were not strong due to the limited budgets of these firms arising from the difficulties in accessing financial support (Ernst and Young 2010). A senior manager at P5 explained how financial controls in that company were so tight that they 'count the paper clips.' Next we examine wider evidence on industry performance and employment drawing on secondary data.

Wider Evidence

An official government report based on a comprehensive industry database outlines that in 2014 the UK pharmaceutical sector employed 70,000 people, including 57,000 in companies discovering, developing and marketing medicines, and had a turnover of £32 billion. Alongside this the medical biotechnology sector employed 23,000 people with a turnover of generated turnover of £5 billion. Combined this gives a sector employing 93,000 in total with a turnover of £37 billion (HM Government 2015a).

Employment trends in the broader chemicals and pharmaceutical sector have mirrored those in the manufacturing sector as a whole, with a 61% reduction in numbers employed between 1979 and 2013 (Hardie and Banks 2014). As outlined in figure 1, despite various fluctuations in manufacturing and R&D employment, overall numbers in the pharmaceutical sector remained quite stable between 1995 and 2012. This does not however take into account the substantial job losses in 2013.

<<Insert figure 1 about here >>

Eurostat data enables some comparative assessment of employment in UK pharmaceutical manufacturing. According to this there were 50,000 people employed in pharmaceutical manufacturing in the UK in 2012, compared with 76,000 in France and 122,000 in Germany (Eurostat 2015).

Wage and qualification levels in the UK sector are comparatively high. The Annual Survey of Hours and Earnings show that in 2013 the median gross hourly wage in pharmaceuticals was £17.63, compared with £12.58 for manufacturing as a whole and £11.59 for all UK employees. Cogent (2010: 11) estimates that 58% of the pharmaceuticals workforce is

educated to National Vocational Qualification level 4 or above (i.e. degree level or above), compared with under 32% for the labour force as a whole.

Gross value added (GVA) in the sector fell quite sharply in 2010 and has been flat since then. It nevertheless remains comparatively high, with GVA per person employed being £135,000 in 2012 compared to £60,000 for manufacturing as a whole (ONS 2015b). Pharmaceuticals has been the largest contributor to the total expenditure on business R&D in the UK since 1988 (ONS 2014). In 2013, the industry invested £4.1 billion, accounting for 22% of the total. The sector had an average annual trade balance of +£4.2bn between 2005 and 2014 (HMRC 2015).

The flexible and lightly regulated nature of the UK labour market regulation was highlighted above as a perceived weakness of the institutional context, by enabling firms and large MNCs in particular to cut jobs with little or no consultation. At the same time the UK continues to attracts a large amount of foreign direct investment in the life sciences sector, with fifty investment projects announced in 2013. This was significantly higher than in France, for example (HM Government 2015b:15). The UK has by far the biggest pipeline of new products in Europe, although the take-up of new medicines by the healthcare sector remains very low (Ernst and Young 2015: 95; HM Government 2015b: 35).

Discussion and Conclusion

While the adoption of a strategic industrial policy has been identified as a possible lever to shift the UK economy to a high wage, high skill trajectory, there has been a lack of related research (Lloyd and Payne 2002). This paper has attempted to address this gap by examining the impact of industrial policy on performance and employment in pharmaceuticals, an

important sector in which government policy and support has historically played a comparatively central role.

The paper began by defining industrial policy, outlining associated measures and instruments identified in the literature and considering its impact on employment. A theoretical framework and analytical tools were outlined which future research can draw on (Hannon et al 2011; Hannon 2014). The challenges in establishing the impact of industrial policy were highlighted (Greene et al 2008). While challenges remain, the research methods adopted comprising interviews with policymakers, qualitative case research at firm level and a wide range of secondary data, aided an overall assessment of the impact of industrial policy on performance and employment in the UK pharmaceutical sector.

The findings demonstrate how the policy and institutional context in the UK facilitated the development of a vibrant pharmaceutical industry. Over the last 10-15 years state industrial policy towards the sector has become more strategic and active. Pharmaceuticals has been identified as a key knowledge-intensive sector and the government has introduced various measures and initiatives and established structures to support it.

The case studies highlighted the importance of UK industrial policy for pharmaceutical firms, with the industrial policy measures from the literature identified as significant for the UK sector. Various aspects or elements as well as the nature and extent of coordination across the same had tangible consequences for firm strategies and consequently employment. The industrial policy framework was seen by industry officials and managers as becoming more positive and favourable over time.

While weaknesses and challenges are apparent overall we can conclude that the industrial policy context has supported the competitive position and performance of the sector and consequently employment. Although total manufacturing employment is substantially lower than in France or Germany, combined pharmaceutical and biomedical activities in the UK constitute a sizable and high value sector characterised by comparatively strong performance and jobs that are highly skilled and paid.

The research makes an important contribution to debates on the political economy of employment and skills in the UK. It demonstrates the potential of an active industrial policy to support growth and competitiveness and consequently underpin high quality jobs (Lloyd and Payne 2002; Brown et al 2015). At the same time the pharmaceutical case highlights the importance of assessment and possible adjustment of policy and institutions in related spheres such as labour market regulation (Hannon et al 2011).

While pharmaceuticals could be seen as something of a special case given the centrality of public policy and institutions to it, there is evidence of some similar patterns of substantial support and collaboration in other sectors, for example automotive (BIS/Automotive Council 2013). This arguably supports and calls for more nuanced analysis of the nature and role of industrial policy in the UK and points to the value of detailed sectoral research as conducted here. More broadly, the research emphasises the general role and importance of industrial policy in supporting high-wage, high-skill employment, even in so-called 'liberal market economy' contexts (Bloch 2008; Hannon et al 2011; Hannon 2014).

From a policy perspective, the importance of proactive, committed and consistent government management and support to the success of industrial policy in the

contemporary economy must be emphasised. That the general role of industrial policy has reportedly been questioned and downplayed by the Conservative administration elected in May 2015 is therefore a cause for concern (Financial Times, June 8th 2015). While unsurprising given the political and contested nature of industrial policy in the UK, the lack of impetus and focus that may result could be detrimental to industry performance and employment.

Finally, for sectors not benefitting from industrial policy support there will continue to be an onus on employment scholars to research and argue for changes in policy and regulatory frameworks that would promote desirable employment and skills outcomes (Grimshaw et al 2008).

Acknowledgements

The primary research for this chapter was supported by the Economic and Social Research Council (award no. RES-062-23-1183).

References

ABPI (2008): *Skills Needs for Biomedical Research: Creating the Pools of Talent to win the Innovation Race*, London: Association of the British Pharmaceutical Industry.

Abraham, J. (2009): 'Partial Progress: Governing the Pharmaceutical Industry and the NHS, 1948-2008', *Journal of Health Politics, Policy and Law*, 34(6): 931-977.

Achilladelis, B. and Antonakis, N. (2001), 'The dynamics of technological innovation: the case of the pharmaceutical industry', *Research Policy*, 30(4): 535-588.

Bianchi, P. and Labory, S. (eds) (2006), *International Handbook on Industrial Policy*, Cheltenham: Edward Elgar.

BIA (2015): *UK Biotech: a Ten Year Horizon*, London: Bioindusry Association/Evaluate Ltd.

BIS (2012): 'Industrial Strategy: UK Sector Analysis', *BIS Economics Paper No. 18*, London: Department for Business, Innovation and Skills.

BIS/OLS (2011) *Strategy for UK Life Sciences*, London: Department for Business, Innovation and Skills.

BIS/Automotive Council (2013): *Driving success – a strategy for growth and sustainability in the UK automotive sector*, London: Department for Business, Innovation and Skills.

Block, F. (2008) 'Swimming against the Current: The Rise of a Hidden Developmental State in the United States', *Politics & Society,* 36(2): 169-206.

BMI (2015): *France Pharmaceuticals and Healthcare Report Q3 2015*, London: Business Monitor International.

Brinkley, I. (2008), *The Knowledge Economy:? The Economic Life of Nations*, London: The Work Foundation.

Brown, P., Cheung, S.Y. and Lauder, H. (2015): 'Beyond a Human Capital Approach to Education and the Labour Market: The Case for Industrial Policy', in D. Bailey, K. Cowling and P. Tomlinson (eds.), *New Perspectives on Industrial Policy for a Modern Britain,* Oxford: Oxford University Press.

Cable, V. (2012): Speech on Industrial Strategy, Imperial College London, September 11.

Chang, H-J. (1994): *The Political Economy of Industrial Policy*, New York: St. Martin's Press.

Clift, B. and Woll, C. (2012) 'Economic patriotism: reinventing control over open markets', *European Journal of European Public Policy*, 19(3): 307-23.

Cogent (2010) *UK Sector Skills Assessment 2011,* Warrington: Cogent (www.cogent-ssc.com)

Cooke, P. and Morgan, K. (1998), *The Associational Economy: Firms, Regions and Innovation*, Oxford; Oxford University Press.

Crafts, N. (2012), 'Creating Competitive Advantage: Policy Lessons from History', pp. 7-35 in D. Greenaway (ed.), *The UK in a Global World: How Can the UK Focus on Steps in Global Value Chains that Really Add Value?*, London: BIS, CEPR, and ESRC.

Daly, A., Hitchens, D. and Wagner, K. (1985): 'Productivity, machinery and skills in a sample of British and German manufacturing plants: results of a pilot enquiry', *National Institute Economic Review*, 111: 48-61.

Coates, D. (2000): *Models of Capitalism: Growth and Stagnation in the Modern Era*, Cambridge: Polity Press.

Coffey, D. and Thornley, C. (2009) *Globalization and Varieties of Capitalism: New Labour, Economic Policy and the Abject State*, Basingstoke: Palgrave Macmillan

Delbridge, R. and Lowe, J (eds.). (1998) *Manufacturing in Transition*, London: Routledge.

DIUS (2008): *Innovation Nation*. London: Department for Innovation, Universities and Skills.

Egeraat, C. van and Barry, F. (2008), 'The Irish Pharmaceutical Industry Over the Boom Period and Beyond', *National Institute for Regional and Spatial Analysis Working Paper Series*, No. 39, Maynooth: National University of Ireland, Maynooth.

Ernst and Young (2010) *Beyond Borders: Global Biotechnology Report 2010*. Ernst and Young (www.ey.com)

Ernst and Young (2015) *Beyond Borders: unlocking value. Biotechnology industry report 2014*. Ernst and Young (www.ey.com)

Etzkowitz, H. and Leydesdorff, L. (2000), 'The dynamics of innovation: from National Systems and ''Mode 2''to a triple helix of university–industry–government relations', *Research Policy*, 29: 109–123

Financial Times (2015): 'Thatcherite to take detailed look at industry: Business secretary will question role of cash-strapped state in economy', London: Financial Times, June 8th.

Finegold, D. and Soskice, D. (1988) 'The Failure of Training in Britain: Analysis and Prescription', *Oxford Review of Economic Policy*, 4(3):21-53.

Froud, J., Haslam, C., Johal, S., Williams, K. And Willis, R. (1998) 'British Pharmaceuticals: A Cautionary Tale', *Economy and Society* 27 (4): 554-584.

Glynn, S. and Gospel, H. (1993): 'Britain's low skill equilibrium: a problem of demand?', *Industrial Relations Journal*, 24 (2): 112-25.

Grant, W. (1982): *Political Economy of Industrial Policy*, London: Butterworth-Heinemann.

Green, A. and Sakamoto, A. (2001) 'Models of High Skills in National Competition Strategies', pp56-160 in P. Brown, A. Green and H. Lauder (eds) *High Skills: Globalization, Competitiveness and Skill Formation*, Oxford: OUP.

Green, F., Ashton, D., James, D. and Sung, J. (1999): 'The Role of the State in Skill Formation: Evidence from the Republic of Korea, Singapore and Taiwan', *Oxford Review of Economic Policies*, 15(1): 82-96.

Greene, F., Mole, K. And Storey, D. (2008): *Three Decades of Enterprise Culture: Entrepreneurship, Economic Regeneration and Public Policy*, Basingstoke: Palgrave Macmillan.

Grimshaw, D., Lloyd, C. and Warhurst, C. (2008) 'A synthesis of findings: the institutional effects on low wage work in the UK and the need for a new policy response' in C. Lloyd, G. Mason and K. Mayhew (eds), *Low Wage Employment in the UK*, New York: Russell Sage Foundation.

Hancher, L. (1990): *Regulating for Competition: Government, Law, and the Pharmaceutical Industry in the United Kingdom and France*, Oxford: Clarendon Press.

Hannon, E. (2014): 'The State and Employment in Liberal Market Economies: Industrial Policy in the UK Pharmaceutical and Food Manufacturing Sectors', pp. 252-271 in M. Hauptmeier and M. Vidal (eds.), *Comparative Political Economy of Work:*, Basingstoke: Palgrave.

Hannon, E., Monks, K., Conway, E., Kelly, G., Flood, P., Truss, K. and Mastroeni, M. (2011) 'The state and industrial policy in Ireland: a case study of the Irish pharmaceutical sector', *International Journal of Human Resource Management*, 22(18): 3692-3710.

Hardie, M. and Banks, A. (2014): *The Changing Shape of UK Manufacturing*, London: Office for National Statistics.

HM Government (2012) *Strategy for UK Life Sciences: One Year On*, London: Department for Business, Innovation and Skills.

HM Government (2015a) *Strength and Opportunity 2014: the landscape of the medical technology, medical biotechnology, industrial biotechnology and pharmaceutical sectors in the UK*, London: Department for Business, Innovation and Skills.

HM Government (2015b): *Life Science Competitiveness Indicators*, London: Department for Business, Innovation and Skills.

HMRC (2015): Overseas Trade Statistics, Interactive Data Tables, (available from www.uktradeinfo.com, accessed July 2015).

HM Treasury (2015): *Fixing the Foundations: creating a more prosperous nation*, London: Her Majesty's Treasury.

HM Treasury/BIS (2014): *Our plan for growth: science and innovation*, London: HM Treasury/Department for Business, Innovation and Skills.

House of Commons (2014): House of Commons Business, Science and Innovation Select Committee, *Oral evidence: The Future of AstraZeneca*, HC 1286-I, Tuesday May 13.

Huggins, R. and Izushi, H. (2007) *Competing for knowledge: creating, connecting and growing*. London: Routledge.

Johnson, C. (ed.) (1984) *The Industrial Policy Debate*, San Francisco: ICS Press.

Keep, E. and Mayhew, K. (1999): 'The Assessment: Knowledge, Skills and Competitiveness', *Oxford Review of Economic Policy*, 15 (1): 1-15.

Lloyd, C. and Payne, J. (2002) 'Developing a Political Economy of Skill?', *Journal of Education and Work*, 15 (4): 365-90.

Lloyd, C. and Mayhew, K. (2010): 'Skill: the solution to low wage work?', *Industrial Relations Journal*, 41(5): 429-445.

Lundvall, B.-Å. (2007), 'National Innovation Systems – Analytical Concept and Development Tool, *Industry and Innovation*, 14 (1): 95-119.

Mayhew, K. (2013): 'Government and Business: an introduction', *Oxford Review of Economic Policy*, 29(2): 249–260.

Mason, G., van Ark, B. and Wagner, K. (1996): 'Workforce Skills, Product Quality and Economic Performance' pp. 175-98 in A. Booth and D. Snower (eds), *Acquiring Skills: market failures, their symptoms and policy responses*, Cambridge: Cambridge University Press.

OLS (2010) *Life Sciences 2010: Delivering the Blueprint*. London: Office for Life Sciences.

ONS (2014): *Business Enterprise Research & Development, 2013*, London: Office for National Statistics.

ONS (2015): *Annual Business Survey 2012* – revised results, London: Office for National Statistics.

Owen, N. (2010): 'The Pharmaceutical Industry in the UK', pp. 129-160 in *Learning from some of Britain's Successful Sectors: An Historical Analysis of the Role of Government*, BIS Economics Paper No. 6, London, Department of Business, Innovation and Skills.

PICTF (2001) *Pharmaceutical Industry Competitive Task Force Final Report*. London: Department of Health/Association of the British Pharmaceutical Industry, March.

Porter, M. (1990) *The Competitive Advantage of Nations*, London: Macmillan Press.

Porter, M. and Ketels, C. (2003): 'UK Competitiveness: moving to the next stage', *DTI Economics Paper no 3*, London: Department of Trade & Industry/Economic and Social Research Council.

Purcell, J. (1989), 'The impact of corporate strategy on human resource management', pp. 67-91 in J. Storey (ed), *New Perspectives on Human Resource Management*, London: Routledge.

Rodrik, D. (2008): 'Normalizing Industrial Policy', *Commission on Growth and Development Working Paper No. 3*, Washington: The International Bank for Reconstruction and Development/The World Bank.

Rueschmeyer, D. and Evans, P. (1985) 'The State and Economic Transformation: Towards an Analysis of the Conditions Underlying Effective Intervention', pp. 44-77 in P. Evans, D. Rueschmeyer and T. Skocpol (eds.), *Bringing the State Back In*, Cambridge: Cambridge University Press.

Stiglitz, J. and Lin, J. (2013): *The Industrial Policy Revolution I*: *The Role of Government Beyond Ideology*, Basingstoke: Palgrave Macmillan.

Thomas, L. (1994) 'Implicit Industrial Policy: the Triumph of Britain and the Failure of France in Global Pharmaceuticals', *Industrial and Corporate Change* 3 (2): 451-89.

TUC (2015): *The Decent Jobs Deficit: the human cost of zero hours working in the UK*, London: Trades Union Congress.

Warwick, K. (2013), "Beyond Industrial Policy: Emerging Issues and New Trends", OECD Science, Technology and Industry Policy Papers, No. 2, OECD Publishing. http://dx.doi.org/10.1787/5k4869clw0xp-en

Weiss, L. (2010) 'The State in the Economy: Neoliberal or Neoactivist?', pp 183-209 in G. Morgan, J.L. Campbell, C. Crouch, O.K. Pedersen and R. Whitley (eds.), *The Oxford Handbook of Comparative Institutional Analysis*. Oxford: Oxford University Press.

Wright, M. (2014): *Making the UK a globally competitive investment environment: The Wright review of advanced manufacturing in the UK and its supply chain.* Available from www.thewrightreport.net (accessed July 10th, 2015).

Table 1: Ten Key Industrial Policy Activities & Associated Measures

Activity	**Summary/Examples**
Provision of direct financial support to R & D intensive or innovative industries	Grants, loans or subsidies targeted to specific firms, sectors or technologies. Assumption of ownership stake in early-stage technology firms
Creation of financial incentives to invest & innovate	Adjustment of tax rates; introduction of R&D tax credits
State funding of public research & development	Strategic investment by government in public institutions in basic or applied research in high-value or emerging areas
Developing clusters & networks	Creating & strengthening links between firms, universities & other institutions in the same industry or region
Strengthening capabilities	Investing in general & industry-specific education & training; public investment in science & technology infrastructure, e.g. research institutes
Attraction of inward investment	Attracting multinational investment, particularly in high value sectors
Regulation of product or service standards	Setting high quality or safety standards, underpinning comparative advantage for indigenous firms; Use of government procurement to raise standards
Stimulation of product market competition	Deregulation & opening industries to competition to promote dynamism & creativity
Business advice & brokering	Helping firms develop their strategies, adopt best management practice and make business connections
Facilitation	E.g. creating supportive regulatory frameworks for new products or ensuring suitable physical infrastructure

Table 2: Overview of the case study firms

Company	**P1**	**P2**	**P3**	**P4**	**P5**
Ownership	MNC	MNC	MNC	MNC	Indigenous/ private
No. of Employees	>2000	>1000	>2000	>2000	>10
Activities	R & D, marketing, sales, distribution	R & D, marketing, sales, manufacturing, distribution	R & D, marketing, sales, manufacturing, distribution	R & D, marketing, sales, manufacturing, distribution	Developing a vaccine to treat liver complaints
No. of interviews conducted	25	20	8	14	5

Table 3: Recent State Initiatives in Support of Pharmaceuticals

Initiative	**Summary**
Biomedical Catalyst Programme	£180 million programme operated by the Medical Research Council & Technology Strategy Board (now Innovate UK) Support for SMEs and academic partners to undertake collaborative R & D projects Grants for Feasibility, 'Confidence in Concept' & later stage projects
Stratified Medicine Innovation Platform & Regenerative Medicine Programme	Led by the Technology Strategy Board Investment of over £60 million & £21.5 million respectively for collaborative R & D in these areas £50 million investment in Precision Medicine Catapult (innovation centre)
Promotion of cell therapy research & biologic manufacture	Cell Therapy Catapult established to promote commercial translation of cell therapy research; works with companies on specific projects. £55 million Cell Therapy Manufacturing Centre announced budget 2014 £38 million National Biologics Manufacturing Centre: large scale open access facility to support companies develop new process technologies for the manufacture of biologic medicines (e.g. antibodies)
Translational Research Partnerships	Involve industry, the NHS & academic researchers working together on early stage clinical development of drugs in critical areas (e.g. inflammatory respiratory diseases) Draw on the government's £775 million investment in Biomedical Research Centres and Units
Financial incentives	Progressive reduction of corporation tax from 26% to 20% Reduced 10% tax on profits from innovations developed & commercialized in the UK from April 2013 ('patent box' system) Adjustment of rules on R & D tax credits and investment allowances to promote investment in SMEs
Reform of Institutions & Processes	Health Research Authority created December 2011 to establish unified approval process & operational standards for clinical trials Office for Clinical Research Infrastructure set up to facilitate linkages between industry, universities and the NHS
Promoting Foreign Direct Investment	Agency UK Trade & Investment has developed a dedicated life sciences marketing & promotion campaign Life Sciences Investment Organisation established to promote inward investment

Sources: interviews, documentation & relevant websites