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## **Priority Sectors in City Regions? Some issues from a study of the Cardiff Capital Region**

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The City Region is becoming the spatial focus for economic development policy across many parts of the European continent. But these functional regions have taken on a new impetus in the UK with the introduction of 'city deals' aimed at improving network and coordination of actors in local authorities. One of the goals of city regions is to improve industrial policy particularly lacking since the abolition of many of the Regional Development Agencies across the UK. However, city regions in developing policy appear to be following in an unquestioning manner the industrial priorities of earlier institutions, and nowhere is this more obvious than in the case of the identification of priority industry development sectors. Too often the selection of industries and clusters for special support has been undertaken in an unquestioning manner. In this paper we focus on the case of the Cardiff Capital Region (CCR). We review approaches to identify priority sectors in this case, and the problems associated with this policy approach.

### **Keywords:**

**City Regions, Industrial strategy, Sector targeting, Priority sectors, Clusters, Wales, Cardiff, Location Quotients, Input-output linkages, High growth sectors**

## 1.Introduction

Regional development policy in most European nations has for some time been built around the fostering of activity in a group of selected industries and/or identified clusters of activity which are geographically concentrated. The work of Egeraat et al (2016) refers to these as territorial production concepts, from the academic literature these have been studied under a plethora of different guises from “industrial districts” (Brusco ,1989), “clusters” (Porter, 1998) to “Industrial Specialization’s” (Kemeny and Stroper, 2014). These concepts have become recognized policy instruments for regional development practitioners throughout the world (for example see, Nadvi, 1995 and Ali, 2012). The idea of crafting regional development policy around areas of relative strength is not a new one in the UK. Since the early 90’s the then Welsh Development Agency sought to concentrate their industrial support in a number of core industries (see for example, Huggins, 1997; Crawley and Hill 2010). This preoccupation in encouraging specific types of industrial activity, and clusters of inter-related activity was brought about as a means to improve regional productivity, a notion that has received much attention (see for example Nathan and Overman, 2013; Delago et al. 2014; Fagerberg and Srholec, 2017). In deed one strand of regional economic strategy in Wales has majored on growth opportunities linked to ‘knowledge industries’. This later became more intensified across the rest of the UK with the then Department of Trade and Investments Cluster reports (DTI, 1999) and then much more recent work on individual industry clusters, Chapain et al (2010) in the creative arts and Bakhshi et al (2015) in nanotechnology. These all leverage the geographical specialization ideas of (Porter, 1998).

The notion of cluster has often followed with the idea of policy makers choosing key or priority industries sometimes referred to as “picking winners”. One of the considerable criticism of this policy has been the lack of economic analysis in showing precisely why such industries and the commodities and services that they produce are likely to promote regional growth, (see for example Buss, 1999; Beath, 2002; Rodrik, 2004; Crawley 2014; Spring, et al 2017: and again in a specific Welsh case in Bryan et al., 2005). In particular, previous reviews of spatial industrial policy identify a general acceptance of the significance of agglomeration in “key industries”, but the choosing of these industries has often been based on what is typically anecdotal and recycled evidence often from regions outside of the UK (see particularly early work of Notta (1991) as well as more recent work from Autio and Rannikko (2016)). Indeed general surveys on key sector and cluster policy across UK regions reveals a strong consensus, not just in policies surrounding key industries but also on the industries that are selected for special attention (Bryan et al., 2005; Crawley, 2014). Feser and Bergman (2000) in an important early review argued that sector prioritisation is rarely questioned and tested and with an allied problem being uncertainty on techniques to undertake analysis and with a paucity of appropriate statistics and data at some geographies.

In this paper we consider the problem of identifying priority sectors in the emerging UK city regions. We use the case of the Cardiff Capital Region (CCR) as a means of illustrating different identification approaches, together with their strengths and weaknesses. The paper makes a plea for policymaker care in identifying priority sectors in the first place, but then argues that if such a policy is a focus, that due diligence should be given to proper identification and with a clear economic rationale. The remainder of the paper is structured as follows. The next section briefly describes a selection of approaches to identify key sectors, while noting that the approaches actually provide different insights into how priority sectors should be understood. The third section provides some background to the CCR, while the fourth section analyses findings for the CCR of employing different approaches to identify priority sectors using readily available data. The final section discusses the findings with respect to the CCR, and specifically addresses whether CCR should simply be prioritising industries that appear to be the focus of efforts in other parts of Wales, the UK economy and indeed regions throughout the EU-27, or whether there is a need to consider other sectors in the local economy that might promote local economic growth. Here we also consider how far support should be focused on investment in industries that might be characterised by an ability to support activity in other local industries, or industries that as they grow, provide economic opportunities for other local industries.

## **2. Priority Sectors in the Local Economy?**

Supposing one wishes to identify priority sectors in a local economy how might it be done, and might there be specific difficulties of undertaking such an analysis at the level of the emerging city regions? There has been a concern that identification of priority industries and clusters at any geographical scale has commonly advanced using relatively crude *ad hoc* methodologies (Crawley and Pickernell, 2013). There are also concerns that identification of existing specialisations using employment or gross value added data (see for example, Feser and Bergman, 2000; Bryan et al., 2005) might not give the most up to date picture of an industry. In what follows we briefly review some possible approaches that might be employed in a city region case, but also show the perspectives on priority sectors that is given by the method together with any issues contingent on using the approach.

At the outset it is important to recognise that when identifying priority sectors, the use of techniques is partly governed by the availability of data but also by the goal of the analyst. Broadly methods have been both qualitative and quantitative, but there have been some attempts to combine these approaches through so called mixed methods. Table 1 provides an overview of the most common techniques to appear in the literature.

*Insert Table 1*

Quantitative techniques have traditionally been the means for identification of priority sectors. They offer a cost effective approach of carrying out exploration without having to collect primary data. Typically methods take one of two forms and either explore specialisation or concentration. Methods to measure concentration seek to estimate the distribution of industries compared to some form of global/national/ regional or country distribution. A common statistic used is the Herfindahl-Hirschman Index (Hirschman, 1964). Contrary to this, specialization measures examine a distribution of industry shares, if a number of industries in an area produce a large share of the particular activity they are said to be specialized. The most common measure is the Location Quotient (Haig, 1928). Some examples of this technique including modifications pertinent to identifying priority sectors can be found in Brenner (2001) and Crawley et al. (2013). Moreover specialisation analysis can be developed to employ some form of mathematical derivation of the inter-linkages (forward and backward trade) between firms in the same industry (see for example Berwert, 2000) using data captured by Input Output (IO) tables. It is noted by Baldwin et al. (2008) that this form of analysis delivers the most credible approach to understand the operation of specialized sectors (and their trading relationships). A review of methods here is provided in Midmore et al. (2006).

The second group of methods are qualitative. These approaches focus on industries that are often identified based on historical strengths or simply raw employment data. These studies vary greatly in depth and also in rigour, often based around a case study approach (Holmes et al. 2005). These studies often allow insights into very specific interactions between firms and can offer valuable insight into how and why activities take place. For example a common method of qualitative analysis is the Four I linkage measure (Hobbs, 2010). The method involves utilising a survey instrument based on four categories that facilitates an enumeration of the significance of individual industry linkages. This method has been adapted for the online tool VLINC to produce industrial linkage maps currently being used across Europe CIT (2016).

The final set of broad approaches adopt a mixed methodology of combining both of the above sometimes referred to as a data triangulation. The most cited of these studies is the work of Porter (1998) who identified industrial clusters within the United States through location quotients and questionnaires designed to understand the inter-relationships between firms. The work of Held (1996) acknowledges that using a priority sector or industry approach requires a mixed method for identifying sectors. Other approaches to mixed methods can be found in Reid et al (2008) who used Social Network Analysis as well as Bryan et al. (2005) that applied Multi-Sectorial Qualitative Analysis (MSQA) to data in Wales.

As Table 1 reveals it is likely that different approaches will give different perspectives on priority sectors in the local economy, with some approaches focusing on trade potential, others examining how far the growth of one industry supports other activity in the local economy, and with others exploring more subtle network linkages in the local economy. So when priority sectors are cited in policy documents there needs to be clarity of why they are identified over and above other sectors, and there should be some transparency as to the methods through which they were identified.

### **3. CCR**

City regionalism is based on the notion that people and firms operate beyond the functional economic areas in which they are situated (Rees and Lord, 2013; Townsend and Champion 2014). A city region approach then focuses around the economic rewards that can occur via scale economies, coordinated policy and investment decisions, and shared risk and reward. A series of continental European regions effectively operate as city regions and the EU has recognised the importance of city regions in achieving connectivity and cohesiveness aims with EU structural funding Gagliardi and Percoco (2017).

The CCR is made up of 10 local authority areas in the South East of Wales. The CCR has a population of around 1.5m or a round half the population of Wales. Access to economic opportunity varies considerably across the region with the relatively more wealthy areas of Cardiff, the Vale and Monmouth, set besides areas of persistent socio-economic disadvantage (including Merthyr Tydfil, Blaenau Gwent and Torfaen) These spatial dissimilarities are discussed in Beynon et al., (2016). Overall GVA per capita in the area is around 20% below the UK average.

The foundation for the Capital region was set in 2011 when the Welsh Government set up a task and finish group to examine the evidence for city regions as growth drivers. A resulting report led to the establishment of a CCR Board in November 2013 with the objective of improving the economic performance of the Region by providing leadership, vision and strategic direction. The details of the CCR City Deal are still being developed but this is expected to represent a £1.28 billion programme, working to gain a: “5% uplift in the region’s GVA by delivering a range of programmes which will increase connectivity, improve physical and digital infrastructure, as well as regional business governance” Cardiff Capital Region Board (2017). Priority sectors have been an important developmental themes across the whole of the Wales, and would appear to be key in informing thinking about the achievement of City Deal targets.

Welsh Government has identified sectors which have included (although with some recent revision): Advanced Materials & Manufacturing (AMM); Construction; Creative Industries; Energy & Environment; Food & Drink; Information and Communications Technology (ICT); Life Sciences; Tourism; Financial and Professional services. (see Welsh Assembly Government, 2017 for an explanation of the sectors and rationale).

There are currently sector groups and panels allied to Welsh Government to promote activity and inward investment in these same sectors. The Priority sectors are defined in terms of Standard Industrial Classifications, and cover a considerable amount of regional (Welsh) economic activity in terms of both employment, and gross value added. Table 2 reveals the amount of employment in 2013 within the CCR local authorities that was in identified Priority Sectors. Given the significance of non-market sector employment in the CCR economy, Table 2 would indicate that a very large amount of private sector employment in the CCR is defined as being within Priority sectors.

*Table 2 about here*

Interestingly priority sector activity is not really described in terms of commodities produced. Then, for example, advanced materials and manufacturing could include both slow growth and declining elements of regional production as well as innovative high technology activity focused in new markets. The importance of these selected priority sectors is being acknowledged at CCR level. The Welsh Government (2015) report *Powering Ahead* makes much of activity in the identified 'Priority Sectors'. For example:

"We need to make investors aware of our skilled workforce; and exciting mix of businesses across the region – which range from aerospace and defence, to life sciences, to marine business services."

*Powering Ahead* also states that the "Welsh Government has identified a number of priority sectors for Wales and the local authorities in the Region have also identified their priority sectors..... For each of our priority and emerging sectors [a subset of those mentioned above], we need to work with the existing pan-Wales sector teams to develop a clear vision and a proposition for investors, which clearly articulate our strengths and global position.... For many of these sectors we need to collaborate with our near neighbours in Wales and further afield to effectively promote them." Welsh Government (2015)

#### **4. Priority Sectors in CCR?**

From the earlier section it becomes clear that there are numerous methods that could be adopted to undertake an analysis/selection of the priority sectors in the CCR. We provide some insights from selected approaches summarised in Table 1.

It immediately becomes clear in what follows that issues of data availability are uppermost, and with this compromising more detailed analysis.

#### 4.1 Location Quotients

Using the simple location quotient (LQ) approach offers a simple snap shot of regional employment specialisation. The LQ is, effectively, a ratio of a ratio allowing for the comparison of characteristics across areas of varying size. The value of an LQ at a regional level indicates how intensive a characteristic is in one place compared to the country as a whole. For the present work, we formulate the traditional LQ as follows:

$$LQ_i = \frac{x_i/n_i}{x/n} \quad (1)$$

In equation (1)  $x_i$  is local employment in industry  $i$ ,  $x$  is the total is the total employment in all industries in the local area.  $n_i$  represent US employment in industry  $i$  and  $n$  the total US employment in all industries. It follows, that if a local area has an LQ greater than one, then it has a greater share in that industry than the national average and thus it could be inferred has a specialization in that area. Table 3 reveals industries defined at the level of 2 digit Standard Industrial Classification where CCR has an  $LQ > 2$ , while Table 4 shows a similar analysis but at the five digit SIC level and with industries shown where there is an  $LQ > 3$ . Clear here is that the level of industry disaggregation is a complicating factor in the analysis. There is also the question of the cut-off point i.e. at what LQ value might an area be termed as having a relative specialisation in a sector. Inevitably there is an element of the subjective here.

While interesting the LQs, on their own reveal very limited information for the city region policymaker. For example the information in Tables 3 and 4 reveal little about the size of the respective industry, its prospects for growth, or whether expansion would serve to support other activity within the CCR. High location quotients at the five digit level might merely reveal that the CCR has one plant in an industry that is not found in other regions of the UK. More fundamentally the analysis in Table 3 defines industries in terms of the standard industrial classification. This might be a poor guide to the commodities that these industries produce.

On the positive side the LQ approach illustrated here can make use of economic data that is available at the city region spatial scale and LQ based approaches have been used in past exercises to identify potential industries of interest in other UK regions, and might represent a simple screening device (see Beynon et al., 2016).

*Insert Table 3 & 4*

### **3.2 Comparative advantages?**

A further way of thinking about priority sectors in the CCR is to consider their revealed competitiveness. For example, in the initial selection of priority sectors at the Welsh level, it was interesting that the identified sectors did not include some of the Welsh industries that are major exporters such as steel and chemicals sectors, plastics manufacturing, automotive, and pharmaceuticals . Then it might be possible to identify priority sectors in the Capital Region based on broad principles of comparative advantage. Important here would be that a city region with the ability to produce goods and services relatively efficiently might then have the greatest benefits from specialising in those same industries. On the downside focusing policy resources in the Capital Region on industries believed to have a comparative advantage could lead to overinvestment in such areas and negative externalities, and more prosaically, why might industries that are already excelling in terms of extra regional or overseas trade need any public support? On the positive, assessing whether identified priority sectors in the Capital Region have, or have the scope to develop, comparative advantage, might provide a useful reality check on the selection of sectors.

This leaves the problem of data availability. How do we know which industries in the city region might have comparative advantage? A simple measure of revealed comparative advantage might be based on a the Capital Region's defined industry exports compared to its industry imports, but this type of data is not available for Wales yet, let alone at the level of the city regions. Then for CCR one way to progress along this route would be to derive inference from national (UK) industry import and export figures, and then identify the presence of such industries in the Capital region. Then this might be a means of refining the analysis based on the data found in Tables 3 and 4.

### **3.3 Well connected industries?**

Input-output tables show the different industries that make up an economy, and show how they fit together in terms of their sales and purchasing patterns. For example different regional industries rely to a greater or lesser extent on local, regional, national and then international markets. Each industry also uses labour inputs, and imports goods and services. Input-Output tables then allow comparisons between industries in terms of their pattern of resource use, and the sectoral and geographical destinations of their outputs, including the level of export activity. Such tables can be used to identify sectors that are important to the local economy by virtue of their spending, employment, exports, or local linkages and consequent economic activity supported directly and indirectly in the Welsh economy. Input-output tables have a wide application in this respect.

For example, Feser and Bergman (2000) reveal that the study of inter-industry linkages in input-output frameworks can assist in forming a foundation for more complex analyses to identify clusters of inter-related activity using methods such as principle components analysis. Potential priority sectors are identified in Input-Output frameworks largely by virtue of the strength of linkages they have with other parts of the economy i.e. approaches then identify sectors which through their growth and development have an 'above average' effect on the local economy (Rasmussen, 1956; Hirschman, 1958; Midmore *et al.*, 2006). Then for CCR such an approach would reveal industries that as they develop, might have strong effects on other local producers of goods and services as these priority industries spend money on these same goods, and as their staffs spend money on goods and services. Table 5 reports on research completed by Midmore *et al.* (2006) and reveals Welsh industries (and many of these are strongly present in the Capital Region) that might be characterised by relatively high linkage effects in the regional economy. The values in the second column are derived using the Rasmussen linkage approach with the value revealing the relative extent to which an increase in final demand for the products of an industry is dispersed throughout the total system of industries in the regional economy.

For CCR such an approach is not without issues. For example can one assume that local industries with greater regional inter-linkages are a solid basis for policy. On the positive extensive transactions linkages between firms in CCR might promote the exchange of technology, skills, and ideas, and with indirect employment creation around a series of 'anchor' firms that are well embedded in the local economy. But care is needed because industries featuring relatively strong local inter-linkages might not equate with those industries that contribute most to the creation of employment and value added, and too strong a focus on inter-industry linkages might ignore the propensity of some industries in CCR to support local households through wages and salaries.

Moreover, industries that are comparatively well inter-linked with other industries in CCR and Wales might not equate with faster growth and/or competitive sectors. Finally there is an issue of whether industries that are well interlinked with others in the local economy can expand i.e. is there a supply side to support growth of such sectors in CCR?

*Insert Table 5*

Inevitably, there are many factors that contribute to firm competitiveness and too much focus on explicit financial transactions may underplay the importance of innovation and knowledge interactions in local economic development. There are also a series of practical analytical issues. While Input-Output tables (on which the analysis in Table 5 is based) are available for the Welsh economy as a whole, the last published tables are for 2007 (see Jones *et al.*, 2010), and these are unavailable for the CCR, although it is likely some inference on industry inter-linkage strength in CCR can be gained from the Welsh tables.

In summary then the input-output framework might be useful in analysing current industrial inter-dependencies, but of less value in informing the priority industries of the future.

## 5. Discussion

The location quotient data tables give an initial start point of where policy makers should focus. When coupled with the Input Output data a picture of the priority sectors begins to emerge. However, this work is just an initial start point. As discussed in the previous section there are limitations to the analysis conducted and without further qualitative analysis to triangulate the findings from the data it would be difficult to be certain.

*Table 6 here*

Table 6 attempts to illustrate some of the problems. Here we take the CCR sectors identified in Table 3 as having relatively high location quotients, but then explore other characteristics of these sectors. For example, Table 6 shows the size of these sectors in terms of employment, revealing that some sectors with high location quotients actually employ relatively few people. Table 6 also shows an index of estimated output per full time employee (FTE) in these sectors. This reveals that some sectors with high location quotients feature relatively lower levels of productivity, and then with CCR policy ostensibly focusing of high productivity sectors in the context of a gross value added per capital gap between the area and UK average.

Importantly Table 6 also uses information contained within the Welsh Input-Output tables to show the expected levels of regional economic activity associated with sector activity. For example, the full-time employment (FTE) multiplier column reveals for the sector 'Manufacture of furniture' that each FTE job in the sector, supports a further 0.46 FTE jobs in the wider economy (here Wales as opposed to CCR, but with a strong expectation that much of the indirect activity is focused in the large capital region) through its purchasing activity and payment of wage incomes. In the case of Manufacture of basic metals each FTE supports a further 1.76 FTE jobs in the local economy. The adjacent column also reports Gross Value Added (GVA) multipliers. For example, for each £1m of GVA directly supported in Manufacture of motor vehicles, a further 1.02m of GVA is supported elsewhere in the regional economy as a result of the regional purchasing of the sector, and the payment of wage incomes.

The corollary here is that even within this small subset of industries in which CCR appears to have some specialisation in terms of employment, these same industries have very different characteristics in terms of size, their productivity characteristics, and their ability to support activity in the regional economy as they grow. Then one conclusion here for the city region is that any selection of priority sectors could involve trade-offs.

Those sectors where the area has some specialisation in terms of employment, might be associated with relatively poor productivity characteristics, or as they grow might support relatively little activity locally. Under these circumstances some form of qualitative linkage analysis would be an ideal further step to allow a greater depth of understanding as to what sectors could be deemed as priority. Any analysis would also need to be regularly updated given the dynamic nature of sectoral changes priority might shift across time.

## **6. Conclusions**

A number of conclusions can be made about prioritisation of sectors at city region level. The rationale for prioritising key sectors or clusters of activity at the level of Wales or its emerging City Regions has rarely been spelled out in any detail. It is not clear why industries in which Wales has gained a 'specialism' actually need any special level of support or promotion. Moreover, by focusing on key priority sectors defined in today's terms by way of standard industrial classification, policymakers might ignore industries that are of future interest but are poorly identified in standard industrial classifications. This is expected to be a particular problem in the CCR where completely new industries could emerge in the city area, and around the Universities which are a principle element of the City Region vision.

Even where a focus on key sectors can be justified then the local economy data that is currently available only allows a very partial analysis of their significance. For example, very little data is available on the international trade linkages of Welsh industries within Wales, let alone those in the CCR. A priority here is improved trade statistics, and more comprehensive regional accounts for Wales that include a better developed Input-Output framework. This becomes even more important in the context of the devolution of some tax powers to Cardiff Bay, and the emerging problems caused by a potential hard BREXIT. Then it is likely that better industrial trade statistics and regional accounts will serve a double purpose.

There is the prospect that some industries which are actually 'key' in the CCR are not included within the current priority list. This is likely to be the case with selected industries that support a large number of transactions in the local economy, or industries that through their growth might work to support a great deal of further industrial activity. For example, the outline analysis presented in Table 6 revealed that sectors where the Capital Region had a specialisation as measured in terms of a concentration of employment (LQ) might actually be industries that through their purchasing and payment of wage incomes actually support relatively little activity regionally. In the same way some sectors with lower location quotients, might actually support very large levels of economic activity indirectly in the region.

Finally here there is also a concern that too much of a focus on what industries produce does not tell us enough about their role in economic development processes. For example, a key

issue for Wales has been in terms of winning investment in firms which are willing to place headquarter functions in the region, and with these firms potentially better embedded, using a wider range of skills, and subject to lower hazard rates.

In conclusion, great care is needed in devoting resources to priority sectors unless there is a careful rationale involved. Policymakers in all city regions need to be aware that the selection of priority sectors could involve a series of trade-offs, and with no one analytical approach able to embrace all of the factors that might make an industry key or not.

## References

- Ali M (2012) Government's role in cluster development for MSEs: Lessons from Ethiopia *CMI report*.
- Autio E, Rannikko H (2016) Retaining winners: Can policy boost high-growth entrepreneurship? *Research policy*, 45(1): 42-55.
- Bakhshi H, Davies J, Freeman A, and Higgs P (2015) The geography of the UK's creative and high-tech economies report , UK London.
- Baldwin J, Brown M, Rigby D (2008) Agglomeration Economies: Microdata Panel Estimates from Canadian Manufacturing. *Statistics Canada Economic Analysis (EA) Research Paper Series*, No 049.
- Berwert A, Mira L (2000) *Cluster-Skizzen für die Bereiche Bau – Agro-Food – ICT: Vorabklärungen im Auftrag des Schweizerischen Wissenschafts- und Technologierates (SWTR) / Technologie- und Innovationspolitik (TIP)*, Schweizerischer Wissenschafts- und Technologierat, Bern (English Translation).
- Beynon M J, Crawley A, Munday M (2016) Measuring and understanding the differences between urban and rural areas. *Environment and Planning B: Planning and Design*, 43(6), 1136-1154.
- Brenner T (2001) Simulating the Evolution of Localised Industrial Clusters – an Identification of the Basic Mechanisms,". *Journal of Artificial Societies and Social Simulation*, 4.
- Bryan J, Jones C, Munday M (2005) Investigating the potential of key sectors using multisectoral qualitative analysis: a Welsh case study. *Environment and Planning C* 23(5): 633–656
- Beath J (2002) UK industrial policy: Old tunes on new instruments?. *Oxford Review of Economic Policy*, 18(2), 221-239.
- Buss F (1999) The case against targeted industry strategies. *Economic Development Quarterly*, 13(4), 339-356.
- Brusco S, Righi E (1989) Local government, industrial policy and social consensus: the case of Modena (Italy). *Economy and society*, 18(4), 405-424.
- Cardiff Capital Region Board (2017) <http://www.cardiffcapitalregioncitydeal.wales/> Accessed on 01.08.17.
- CIT (2016) The V-LINC Tool <http://www.cit.ie/vlinc> Accessed on 03.08.17.
- Chapain C, Cooke P, De Propriis L, MacNeill S, Mateos-Garcia J (2010) Creative clusters and innovation. *Putting creativity on the map*. London: NESTA.

- Crawley A, Hill S (2011) Is industrial agglomeration increasing? New evidence from a small open economy. *Journal of Economic Studies*, 38(6), 725-740.
- Crawley A, Pickernell D (2012) An appraisal of the European cluster observatory. *European Urban and Regional Studies*, 19(2), pp.207-211.
- Crawley A, Beynon M, and Munday M (2013) Making Location Quotients more relevant as a policy aid in regional spatial analysis. *Urban Studies* 50(9), 1854-1869.
- Crawley A (2014) A Shopping List Approach to Regional Development: A Cautionary note on the Application of Smart Specialisation. In: 61st Annual North American Meetings of the Regional Science Association International, Washington DC, USA, 12-15 November 2014.
- Delgado M, Porter M, and Stern S (2014) Clusters, convergence, and economic performance. *Research Policy*, 43(10), 1785-1799.
- DTI (2001) *Business Clusters in the UK - A First Assessment*. Department of Trade & Industry, London.
- Egeraat C, Morgenroth E, Kroes R, Curran D, and Gleeson J (2016) A measure for identifying substantial geographic concentrations. *Papers in Regional Science*. Epub ahead of print 29 July 2016. DOI: 10.1111/pirs.12241
- Finkle A (1999) The case against targeting might have been more . . . targeted. *Economic Development Quarterly*, 13(4),: 361-364.
- Feser EJ, Bergman EM (2000) National Industry Templates: A Framework for Applied Regional Cluster Analysis. *Regional Studies* 34.(1): 1-19.
- Fagerberg J, Srholec M (2017) Explaining regional economic performance: the role of competitiveness, specialization and capabilities. *Handbook of Regions and Competitiveness: Contemporary Theories and Perspectives on Economic Development*, p.117.
- Gagliardi L, Percoco M (2017). The impact of European Cohesion Policy in urban and rural regions. *Regional Studies*, 51(6), 857-868.
- Held JR (1996) Clusters as an Economic Development Tool: Beyond the Pitfalls. *Economic Development Quarterly*, vol. 10 (3)249-261.
- Hirschman AO (1964) The Paternity of an Index. *The American Economic Review* 54 (5): 761.
- Hobbs J (2010) A Framework for the Analysis of Spatial Specialisations. PhD thesis, Cork Institute of Technology, Ireland
- Holmes J, Rutherford T and Fitzgibbon S (2005) *Innovation in the Automotive Tool, Die and Mould Industry: A Case Study of the Windsor-Essex Region*, in D. Wolfe and M. Lucas eds. Global Networks and Local Linkages: *The Paradox of Cluster Development in an Open*

*Economy*. Kingston: Queen's School of Policy Studies Innovation Systems Research Series. Kingston: McGill-Queen's University Press. 119-154.

Huggins R (1997) Regional competitive specialization. Development agency sector initiatives in Wales. *Area*, 29(3), 241-252.

Kemeny T, Storper, M (2015) Is specialization good for regional economic development?. *Regional Studies*, 49(6), 1003-1018.

Nathan M, Overman H (2013) Agglomeration, clusters, and industrial policy. *Oxford Review of Economic Policy*, 29(2), 383-404.

Nadvi K (1995) *Industrial clusters and networks: Case studies of SME growth and innovation*. United Nations Industrial Development Organization Report. UN.

Notta N (1991) Trying to understand the ed official's dilemma. In D. Kenyon & J. Kincaid, (Eds.), *Competition among local and state governments* (pp. 247-250). Washington, DC: Urban Institute.

Porter ME (1998) Clusters and the New Economics of Competition. *Harvard Business Review*. 76.6: 77-90.

Rees J, Lord A (2013) Making space: Putting politics back where it belongs in the construction of city regions in the North of England. *Local Economy*, 28(7-8), 679-695.

Reid N, Smith B, Carroll, M (2008) Cluster regions: A social network perspective. *Economic Development Quarterly*, 22(4): 345-352.

Rodrik D (2004) Industrial policy for the twenty-first century. CEPR Discussion Paper No. 4767

Spring M, Hughes A, Mason K, McCaffrey, P (2017) Creating the competitive edge: A new relationship between operations management and industrial policy. *Journal of Operations Management*, 49, 6-19.

Townsend A, Champion T (2014) The impact of recession on city regions: The British experience, 2008–2013. *Local Economy*, 29(1-2), 38-51.

Welsh Government (2015) Powering Ahead

<http://gov.wales/docs/det/publications/150306cardiffcapitalregionen.pdf> Accessed on 03.08.17

Wiewel W (1999) Policy research in an imperfect world: Response to Terry F. Buss, "The Case Against Targeted Industry Strategies." *Economic Development Quarterly*, 13(4), 357-360.

**Table 1. Summary of Methods for Priority Sector Analysis**

Methodology	Technique	Primary data	Focus
Quantitative	Input-output analysis	Input-output matrices	Trade linkages between industries in the value chain in the economy
Qualitative	Correspondence analysis	Innovation surveys	Groups of firms or industries with similar innovation styles
Qualitative	Case studies	Qualitative data combined with trade statistics and national accounts	Factors affecting the competitiveness of industries and nations
Quantitative	Concentration Measures	Employment and industrial data	The spatial distribution of economic activity
Quantitative	Specialisation Measures e.g. location quotients	Employment and industrial data	Focuses on the relative intensity of an industrial in a given locality compared to some form of global average.
Quantitative and Qualitative	Multi-sectoral qualitative analysis MSQA	Industrial Data and Qualitative interview and primary data	Mixed methods, focuses on expert analysis of industry strengths supplements by quantitative tools
Quantitative and Qualitative	Social Network Analysis	Employment and Industrial Data/Primary data at firm level	Focuses on the interaction of agents within an industrial domain

**Table 2. 2013 Employment in Identified Priority Sectors**

<b>Priority sector</b>	<b>Cardiff Capital Region employment (000s)</b>
Advanced materials and manufacturing	85.9
Construction	103.5
Creative industries	48.8
Energy and environment	143.8
Food and farming	45.3
Financial and professional services	107.2
ICT	28.9
Life sciences	11.8
Tourism	123.3
In a priority sector	556.6
Other not in a priority sector	745.6
Total	1302

Source: Welsh Government

**Table 3 Cardiff Capital Region with Location Quotient > 1.5 2013**

<b>Industry (SIC 2007 2 digit)</b>	<b>LQ</b>
39 : Remediation activities and other waste management services.	3.73
05 : Mining of coal and lignite	3.29
65 : Insurance, reinsurance and pension funding etc	2.04
33 : Repair and installation of machinery and equipment	1.97
31 : Manufacture of furniture	1.94
29 : Manufacture of motor vehicles, trailers and semi-trailers	1.89
35 : Electricity, gas, steam and air conditioning supply	1.88
22 : Manufacture of rubber and plastic products	1.78
32 : Other manufacturing	1.76
21 : Manufacture of basic pharmaceutical products and pharmaceuticals	1.75
27 : Manufacture of electrical equipment	1.74
18 : Printing and reproduction of recorded media	1.69
38 : Waste collection, treatment and disposal activities; materials recovery	1.65
84 : Public administration and defence; compulsory social security	1.58
24 : Manufacture of basic metals	1.56
17 : Manufacture of paper and paper products	1.53

Derived from information from Office for National Statistics.

**Table 4: Industries in Cardiff Capital region with LQ > 3.0: 2013**

Industry (SIC 2007 5 digit)	LQ
32110 : Striking of coins	44.85
52211 : Operation of rail freight terminals	29.05
27200 : Manufacture of batteries and accumulators	20.47
20170 : Manufacture of synthetic rubber in primary forms	13.70
13931 : Manufacture of woven or tufted carpets and rugs	7.74
33160 : Repair and maintenance of aircraft and spacecraft	7.67
27310 : Manufacture of fibre optic cables	7.43
26309 : Manufacture of communication equipment	7.42
23140 : Manufacture of glass fibres	6.98
81291 : Disinfecting and extermination services	6.37
05102 : Mining of hard coal from open cast coal working (surface mining)	6.37
10860 : Manufacture of homogenised food preparations and dietetic food	6.18
87200 : Residential care activities	5.84
13922 : Manufacture of canvas goods, sacks etc	5.41
30920 : Manufacture of bicycles and invalid carriages	5.29
28940 : Manufacture of machinery for textile, apparel and leather production	4.60
24100 : Manufacture of basic iron and steel and of ferro-alloys	4.09
18121 : Manufacture of printed labels	4.00
23990 : Manufacture of other non-metallic mineral products nec	3.88
08990 : Other mining and quarrying nec	3.84
31010 : Manufacture of office and shop furniture	3.75
39000 : Remediation activities and other waste management services	3.73
20160 : Manufacture of plastics in primary forms	3.70
27510 : Manufacture of electric domestic appliances	3.63
20120 : Manufacture of dyes and pigments	3.60
65202 : Non-life reinsurance	3.58
46640 : Wholesale of machinery for the textile industry etc.	3.41
23510 : Manufacture of cement	3.41
26110 : Manufacture of electronic components	3.24
26600 : Manufacture of irradiation, electromedical and electrotherapeutic eqpt.	3.22

Derived from Office for National Statistics

**Table 5 Industries in Cardiff Capital region with Strong Backward Linkages to other Industries in the Welsh Economy**

Sector	Linkage Indicator
Recreation/Welfare	1.302
Dairy Products	1.135
Meat Processing	1.127
Insurance	1.101
Construction	1.095
Sanitary Services	1.078
Confectionery & Misc. Foods	1.073

Source: Midmore et al. (2006)

**Table 6 Cardiff Capital Region: Selected Sector Characteristics**

Industry	Cardiff Capital Region Location Quotient	Employment in Cardiff Capital Region, 2014	Output per FTE Index (All Welsh sectors =100)	FTE multiplier	GVA multiplier
39: Remediation activities and other waste	3.73	<400	49.74	1.78	1.41
05 : Mining of coal and lignite	3.29	<400	42.20	1.61	1.74
65 : Insurance, reinsurance and pension	2.04	4500	18.70	1.50	2.17
33 : Repair and installation of machinery	1.97	4900	18.32	1.28	1.36
31 : Manufacture of furniture	1.94	3100	46.60	1.46	1.37
29 : Manufacture of motor vehicles etc	1.89	5600	73.86	1.94	2.02
35 : Electricity, gas, steam	1.88	4500	na	na	na
22 : Manufacture of rubber and plastics	1.78	5800	31.88	1.37	1.43
32 : Other manufacturing	1.76	2800	25.43	1.27	1.40
21 : Manufacture of basic pharmaceuticals	1.75	1500	27.05	1.41	1.48
27 : Manufacture of electrical equipment	1.74	3100	39.24	1.51	1.46
18 : Printing and reproduction media	1.69	3800	26.56	1.30	1.35
38 : Waste collection, etc	1.65	4300	49.74	1.78	1.41
84 : Public administration and defence	1.58	44200	26.88	1.44	1.40
24 : Manufacture of basic metals	1.56	2300	149.14	2.76	1.86
17 : Manufacture of paper/products	1.53	1600	72.03	1.67	1.50

Note: Multipliers and output per FTE estimated from the Welsh Input-Output Tables (see Jones et al., 2010).