

# High-Technology Clusters: Specialisation and Interaction<sup>1</sup>

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## 1. Introduction

One of the interesting dynamic features of many high-technology clusters is an increase in the division of labour, and hence an increasing fragmentation of production. One striking example of this is in the manufacture of personal computers (PCs), where it has become almost meaningless to ask in what country a PC is manufactured. The various components of a PC are manufactured in many different countries, assembly may be done in more than one country, and the final "badge" may be added somewhere else again. Particular companies (and indeed particular clusters) may become specialised in just one particular activity within the overall process of PC manufacture. This specialisation and fragmentation of production depends on interaction between the different activities, and hence on cost-effective communication and transportation.

The objective of this paper is to describe and analyse a simple model of the comparative efficiency of several different industrial structures. At one end we examine the co-location of all production with final consumption; at the other, we examine the emergence of specialised clusters each focusing on just one stage of production. The model shows how this comparative efficiency depends on economies of scale and scope, economies of agglomeration and congestion costs, and on costs of communication and transportation. The model also explains how the degree of codification of the production process influences this comparative

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efficiency, and hence explains why we may see a marked change in clustering over a product life cycle.

The paper is relevant to the process of clustering in many European countries, but especially relevant to issues arising in the United Kingdom. The British government has adopted clustering as a major instrument of industrial policy, and believes it has a role in helping to revive the economies of poorer regions. Unfortunately however, much of the clustering observed in practice is a further concentration of activity into the over-heated South East of England. The paper concludes by asking if there are any components of cluster policy that might enhance regional prospects and slow down the over-heating of the South East.

The rest of the paper is arranged as follows. Section 2 describes in a very cursory way some of the key ideas in the literature about the interplay between the emergence of clusters and the growth of specialisation. It makes no claim to comprehensiveness, but identifies the main ideas used in this paper. Section 3 then sets out our basic model of clustering, interaction and specialisation. This model is in two parts: a model of production costs (depending on scale, scope, and agglomeration economies) and a model of transportation and communication costs. Section 4 illustrates the workings of this model by considering the case of a production process that can be split into four parts. Demand is inelastic, and is dispersed over a wide geographical area, with customers grouped into cities, towns and villages, and we consider five industrial structures for producing the necessary output required to satisfy demand. Sections 5 and 6 explore how the efficiency of different industrial structures depends on the various parameters identified in Section 3. This relationship is summarised by means of two different diagrams - a simple 'map' in Section 5 and a 'radar' chart in Section 6. Section 7 concludes with some observations about the implications of this model for industrial policy towards clusters, with special reference to the UK.

## **2. Underlying Ideas**

In relating this paper to the wide literature on clusters, a few main points need to be made. As Martin and Sunley (2003) show, the use of the term 'cluster' is not standardised in the literature, and this can lead to considerable confusion. For example, some definitions imply rich interaction between those companies in the cluster while other definitions imply little more than co-location, without any necessary interaction between companies. Moreover, while there is general agreement that a high-tech cluster contains a disproportionately high concentration of particular high-tech industrial sub-sectors, the exact breadth of this portfolio is not defined.

In this paper, we are concerned with one specific aspect of clustering: the tendency for production in a particular industry to become vertically disaggregated, with particular companies and particular clusters specialising in a particular part of the value chain. As such, an essential building block for our analysis is the division of labour and those factors that influence it.