Sectoral composition and productivity differences: A regional analysis with particular reference to the North East region of England

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"To my dear father (Mr Sukhdev Singh) and my mother (Mrs Charan Kaur)"

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Abstract

For the period 1991-2000 the North East region experienced the slowest productivity growth rate relative to its UK regional counterparts. Manufacturing is a prominent feature of the North East landscape; to this effect the relationship between regional growth differentials and regional differences in industrial composition are explored using a technique known as shift share analysis. Output per worker data for the North East (and UK regions) for the period 1991-2000 is used to examine whether the slow productivity growth performance is attributable to the regional industrial structure. The empirical results reveal that differences can be explained by region-specific productivity differentials. These differences are attributable primarily to differences in the regions' labour productivity of given industries as opposed to between regions in sectoral composition of their economies.

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None of the material contained in this thesis has previously been submitted for a degree in the University of Durham or any other University.

The author is responsible for the entirety of this thesis

Statement of Copyright

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"There is as yet no extensive academic work on the issue of industrial composition and productivity growth at the regional level." (HMT & DTI, 2001a, pp. 20)

Chapter 1: Introduction

This thesis will explore whether the industrial composition of the North East is a major explanation of its slow growth process and assess whether productivity gaps are diminishing (converging) or increasing (diverging) over time across the UK regions. The time frame of the empirical research is confined to the period 1989-2000 based on data availability; therefore it does not look beyond this period. This chapter will introduce the composition of this thesis and the subsequent chapters within it.

In 1997[1] the Government set out its central economic objective of achieving high and stable levels of growth and employment. In order to achieve this objective the Government has put in to place a programme of economic reform to secure macro-economic stability, ensure employment opportunities for all and narrow the productivity gap[2]. In 1999 the UK's Department for Trade and Industry first published the '*UK Competitiveness Indicators'*. The UK Government was one of the first European Union (EU) governments to put competitiveness at the heart of economic policy making. The purpose of the indicators was to: monitor the UK knowledge driven economy; assess its competitiveness against the world's leading economies; and to help design policies to narrow the gap in productivity and living standards with its main competitors.

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[1] Statement by the Chancellor of the Exchequer to the Bank of England on 6th May 1997.

[2] Productivity is the main determinant of national living standards and refers to how well an economy uses the resources it has available by relating the quantity of inputs to outputs.

In a report published by the UK Treasury (2000a) titled *'Productivity in the UK: The Evidence and the Governments Approach'* two determinants of growth are identified to enable the Government to achieve its central economic objective of achieving high and stable levels of growth and employment. The first determinant is employment, that is how many people are working and the second determinant is productivity, which is how productive they are, under which five key factors that underlie productivity are also identified (skills, investment, enterprise, competition and innovation).

Growth and productivity are also on the policy agenda in most of the Organisation for Economic Co-operation and Development (OECD) countries, as they seek to enhance their economic performance, raise standards of living and address a range of socio-economic challenges. The OECD work on growth and the 'new economy' indicated great diversity in growth and productivity performance in the OECD area and identified a range of policies that could enhance growth (OECD, 2001a). According to an OECD working paper study, (OECD, 2003a; 2003b) estimates of labour productivity growth suggest that the United States has experienced faster labour productivity growth than most EU countries for the period 1996-2000.

Productivity has been placed as a top priority for the UK Government. By increasing productivity, the Government aims to raise the UK's trend growth rate (HMT, 2000a). At the regional level, the Government has recognised that in order to achieve its central economic objective it needs to reduce the significant and persistent differences in economic performance between and within UK regions in the provision of skills, investment, innovation, enterprise and competition (DTI & HMT, 2001).

> *...to achieve these objectives productivity and employment must improve in every part of the UK – not just those countries and regions that historically have had the highest growth.* HM Treasury & DTI (2001) p. V

To this effect, the UK Government also introduced a number of institutional reforms such as the introduction in England of the Regional Development Agencies (RDAs); the London Development Agencies and at the local level with the creation of Strategic Partnerships[3]. The RDAs are the key agents in driving forward this new regional industrial policy. As the strategic leaders in the regional and local economic development, their regional economic strategies set out a shared vision of the challenge each region faces.

Chapter two examines the major theoretical schools and approaches which either explicitly or indirectly explain the phenomenon of regional growth differences. There exist diverse theoretical approaches that lend themselves to explain the regional growth differences. The key to the success of a regional policy lies in a thorough understanding of the regional growth process. It is differences in the growth performance of individual regions, which give rise to the economic disparities that triggered the desire for a regional policy. Over the past fifty years interest in understanding the regional growth process led to the testing and developing of various regional growth theories. Of particular significance has been the issue of whether the regional growth process is fundamentally convergent or divergent in nature. That is to say, in the absence of government policies, would the automatic functioning of the economic system lead to regional economic disparities narrowing or

[3] A Local Strategic Partnership (LSPs) is a single non-statutory, multi-agency body, which matches local authority boundaries, and aims to bring together at a local level the different parts of the public, private, community and voluntary sectors. LSPs are considered key to tackling deep seated, multi-faceted problems, requiring a range of responses from different bodies. Local partners working through a LSP are expected to take many of the major decisions about priorities for their local area.

widening over time. Debates within the arena of regional economics have tended to run in parallel with similar debates on this issue at the national and international level.

The starting point for many regional economists has been neo-classical[4] growth theory (Borts & Stein, 1964; Siebert, 1969; Richardson, 1973). This model was essentially a convergence model of regional growth and its widespread acceptance for many years led to the view that regional disparities were the result of the failure of neo-classical convergence process to function properly. In contrast to this school are demand orientated models of regional growth, such as the model of cumulative causation proposed first by Myrdal in 1957 and then by Kaldor in 1970. The central argument of Kaldor's model of cumulative causation is that regions that can specialise in manufacturing or in certain process activities can enjoy economies of scale and other benefits from specialisation (labour productivity gains leading to increased competitiveness which would induce demand for a region's products leading to output growth feeding back into productivity gains) via a circular and cumulative development process.

Since the 1980s two principal regional growth models[5] have emerged. The first being *"endogenous growth theory"* initiated the work of Romer (1986) and rests on the central idea that a production factor must not have

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[4] In the traditional neo-classical models the growth process is essentially supply driven. The pace of a region's growth is dependent upon how fast the labour force expands over time, how rapidly capital accumulation occurs, and the speed at which technological progress occurs. Differences between regions can arise for any one or a combination of all three reasons.

[5] New growth models revolve around a few simple but obvious ideas that have been anticipated by earlier economists, most notably Adam Smith (1776) and David Ricardo (1812). Many of the interesting aspects of the new growth models are related to the classical perspective that their authors (often unwillingly) take on the problem of growth, whereas some of their shortcomings derive from the lack of solutions to the problems of the neo-classical theory of growth which were put into sharp relief during the 1960s and 1970s

diminishing returns. The second being *"new economic geography"* a radical new approach developed by Krugman and Venables (1995) in the early 1990s. The idea of agglomeration economics, as suggested by Marshall's externalities (Marshall, 1920) and cumulative causation, as initiated by Myrdal (1957) is revived in the *new economic geography* approach. The potential significance of external economies resulting from the geographical clustering of industry and the role of these in the growth process are a prominent feature of the new economic geography model. Endogenous growth theory is the economic paradigm that is driving public policy. Chapter two explores these major theoretical schools and approaches which attempt to explain the phenomenon of regional growth differences in depth.

Chapter three of this thesis sets out the UK Government's ambition to reduce productivity gaps in search of achieving high and stable levels of economic growth. The two determinants of growth (employment and productivity) and the five drivers that underlie productivity are contextualised at the UK regional level with emphasis on the North East region to establish the extent of regional disparity. The North East regional economy has experienced the slowest average annual productivity[6] growth during the period 1991-2000 relative to its regional counterparts[7]. Chapter three will also discuss the role of UK regional policy which aims to reduce regional disparities. It is widely recognised that persistent regional disparities have a profound negative effect on the national economy (Armstrong & Taylor, 2000). The role of regional policy is to reduce regional disparity and enhance economic growth. The UK Government opted to deal with regional disparities by adopting the market failure approach, which requires government intervention. According to Gordon Brown (2000), UK regional policy can be identified

[6] Productivity growth as measured by output per worker.

[7] Based on authors calculation further discussed in Chapter 4 section 4.9.1.

by three distinct phases. The first phase is characterised by first-aid measures, assisting areas of high unemployment, the second phase is characterised by inward investment and the third current phase is captured by small firm creation and entrepreneurship.

The UK Government's view of regional policy changed radically during the early 1990s. Regional policy had become entrenched as a component of the Nation's *'Industry Policy'* (Armstrong & Taylor, 2000). In particular, the emphasis was placed on integrating regional policy into the drive to improve the *competitiveness* of industry in international markets. However, the 1995 White Paper on *'Regional Industrial Policy'* argued that the principal aim of regional policy should be to increase the competitiveness of the Assisted Areas[8], both in terms of suitable locations for industrial activity and competitiveness of individual firms within them. The 1995 White Paper further pointed out a re-emergence of social objectives, which during the recession of the early 1990s had not been considered.

Chapter four discusses the role of manufacturing in the national context. Prior to the 1960s the UK was a major manufacturing nation, where the big cities were the centre of economic activity. However since the mid 1960s there have been a number of changes to the national and regional economy. Changes include the decline in manufacturing industry, the growth of employment in the service sector, the transformation of the geography of industry, the changing nature of work and shifts in the structure of the labour market (Allen & Massey, 1992; Evans *et al.*, 1995; Hudson, 2000). Despite these changes to manufacturing it continues to

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[8] The Assisted Areas are those areas of Great Britain where regional aid may be granted under European Community law. Regional Selective Assistance (RSA) is the main form of such aid in Great Britain. It is a discretionary grant, awarded to secure employment opportunities and increase regional competitiveness and prosperity.

be a prominent feature of the North East economy, hence the primary reason for its consideration.

In essence, Chapter four consists of three distinct parts. The first part explores the three dominant perspectives surrounding the role of manufacturing in economic growth. The first perspective considers manufacturing as an 'engine of growth' (Lewis, 1954; Kaldor, 1966). The second perspective argues that the decline in manufacturing is an inevitable process of historical evolution (Fischer, 1935; Rostow, 1960). The third perspective has been brought about by globalisation[9] of which offshore outsourcing of manufacturing is a prominent feature. The second part of this chapter introduces the UK Government's perspective on the role of manufacturing, in particular attention is given to the UK manufacturing productivity gap relative to its international counterparts that has regional implications. The final part of Chapter four commences by briefly discussing the sectoral composition of the UK and its regional counterparts with regards to employment and Gross Value Added (GVA). Thereafter the sectoral regional annual average productivity and employment growth rates are discussed for the period 1991-2000.

Chapter five introduces the data, methodology and develops several principal and sub hypotheses[10] to be tested in the subsequent chapters. The hypotheses (*H*) introduced in Chapter five can be broadly broken down into two parts. The first part aims to examine the role of the industry mix in explaining the North East poor productivity growth performance (*H1-H2*) and the second part assess whether differences in

[9] A term frequently used to identify a trend toward increased flow of goods, services, money, labour and ideas across national boundaries and the subsequent integration of the global economy.

[10] The sub hypotheses are split into two distinct categories; the first category represents manufacturing sub sectors which are based on subsection level data; the second category represents the sectors which make the total economy and therefore includes manufacturing and is based on section level data. Chapter five, section 5.3.3 explores the level aggregation.

output per worker across regions diminish (converge) or increase (diverge) over time, enabling one to measure whether productivity gaps are widening over time across the UK (*H3-H9*) which are underpinned by well established statistical methods.

Chapters six and seven test the hypotheses derived in Chapter five. Chapter six reveals that there are regional differences in labour productivity in the UK and that these differences are primarily attributable to between-region differences in the labour productivity of given industries as opposed to between-region differences in the sectoral composition of the industrial economy (*H1 & H2*).

Chapter seven discusses the results obtained in relation to the two non-parametric tests and the three conventional measures of inequality (Coefficient of variation, Theil coefficient and Gini coefficient). The first non-parametric results for the North East's total economy reveal that the ranking of productivity growth rates of sectors at the national level coincided with those at the regional level (*H3a*). Conversely the results for manufacturing sub sectors revealed that there is no systematic ranking relationship between the North East and the UK (*H3b*). The second non-parametric test revealed that the productivity level trend path of regions is static (*H4*).

The coefficient of variation results point to regional (H5) and sector (H6) specific factors based on the t-test results. The Theil coefficient showed total inequality over time to be converging for the manufacturing sub sectors with regards to the regional and sectoral analysis. However the results for the total economy revealed that total inequality was diverging over time with regards to the regional and sectoral analysis (H7-H8). The Gini coefficient results proved to be inconclusive.

Chapter eight concludes this thesis and finds distinct evidence that productivity gaps between UK regions are diverging and that these differences are attributable primarily to between-region difference in the labour productivity of given industries rather than between-region differences in the sectoral composition of the industrial economy. In addition, this thesis finds that the North East is relatively inefficient in all sectors hence manufacturing is not different from services which is explained almost entirely by region specific factors. The implications of this are discussed in the conclusions.

Chapter 2: Theories of Regional Economic Growth

Introduction

Chapter one revealed, that by increasing productivity, the Government aims to raise the UK's trend growth rate (HMT, 2000a). The Government recognises that by tackling the significant and persistent differences in economic performance between and within UK regions lie at the heart of achieving the Government's economic ambition to raise the UK's trend growth rate.

This chapter will therefore provide an overview of the major theoretical schools which either explicitly or indirectly explain the phenomenon of regional growth differences. It will also assess the relevance in explaining regional growth disparities. The aim of this chapter is to discuss the major theories in the explanation of regional disparity as well as the determinants of regional growth.

2.1 Major theories in the explanation of regional disparities

The key to the success of regional policy lies in a thorough understanding of the regional growth process. It is differences in the growth performance of individual regions which give rise to the economic disparities which have triggered the desire for regional policy. Hence, over the past fifty years interest in understanding the regional growth process has lead to the testing and developing of various regional growth theories as can be seen in Figure 1.

Of particular significance has been the issue of whether the regional growth process is fundamentally convergent or divergent in nature. (This is discussed in more depth in Chapter five, section 5.10.1). That is to say in the absence of government policies would the automatic functioning of the economic system lead to regional economic disparities narrowing over time or widening? Many debates within the arena of regional economics have tended to run in parallel with similar debates on this issue at a national and international level.

Generally theories which were proposed in regional economics have followed closely the prevailing paradigm of general economic theory. Thus the neo-classical approach and in particular the neo-classical model of growth had a strong influence on regional growth theory[11]. This lead to the neo-classical model of regional growth in the 1960s and 1970s, proposed by Borts and Stein (1964), Siebert (1969), and Richardson (1973), which stresses the supply side[12]. One of the key predictions of the neo-classical growth model is that spatial disparities in per capita incomes should converge over the long run; the key assumption being capital is subject to diminishing returns[13]. In contrast to this school are demand[14] orientated models of regional growth, such as the model of cumulative causation proposed first by Myrdal in 1957 and then by Kaldor in 1970. Cumulative causation is a spiral build-up of advantages that occurs in specific geographic settings as a result of the development of external economies, agglomeration effects, and localization economies; in essence it means self perpetuating. At this point it is important to note that the

[11] These models are sometimes referred to as models of exogenous growth.

[12] Supply side factors such as labour force growth, the growth of capital stock and technical change. Hence the growth process is essentially supply driven. How fast a region grows is dependent upon how fast its labour force expands over time, how quickly capital accumulation occurs.

[13] In economics diminishing returns is the short form of diminishing marginal returns, the concept that, as more of an input is applied, each additional unit produces less and less additional output.

[14] The focus on the demand side of the regional economy means a change in the time scale, hence taking into account a much nearer time horizon.

neo-classical approach is concerned with the very long term, whereas the demand based approach focuses more on the medium term[15].

Traditional neo-classical and Kaldorian growth models have been replaced by a new generation of growth theories16. The new generation of growth theories has participated less in the formation of theories of growth but instead regional economics shifted its focus more towards regional policy issues in the 1980s, with a stronger focus on policy measures and an emphasis on the micro-economic level. Thus regional economics has participated less in the formation of theories of regional growth and has shifted its own focus more towards regional development policies. Beyond the traditional paradigms of regional growth, regional economics did not further engage in theoretical questions of regional growth. Instead regional economics shifted its focus to regional policy issues in the 1980s, with a stronger focus to regional policy measures and an emphasis on the micro-economic level. That regional policy has employed new general economic models, which were suggested by new growth theory and later by the new economic geography, merely as the theoretical explanation of regional growth differences and as a justification for policy intervention.

Lovering (1999) refers this shift towards regional development polices as '*theory led by policy*'. Lovering (1999) argues that regional policy has employed economic models which were suggested in new growth theory (often referred to as endogenous growth theory) and later by new

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[15] Most economists agree on the definition of 3-5 years for the short run, 5-20 years for the medium-long term and 20+ for the very long term.

[16] New growth models revolve around a few simple obvious ideas which have been anticipated by earlier economists, most notably Adam Smith and David Ricardo. Many of the interesting aspects of the new growth models are related to the classical perspective that their authors (often unwilling) take on the problem of growth, whereas some of their shortcomings derive from the lack of solutions to the problems of the neo-classical theory of growth which were put into sharp relief during the 1960s and 1970s

economic geography[17], merely as the theoretical explanations of regional growth differences and as a justification for policy intervention.

Regional policy, which constitutes the economic policy line of regional economics, pursues a different focus than regional growth theory. According to Tondl (2001) scholars in regional policy wish to propose policy strategies which should lead to regional development[18], e.g. the export-led growth strategy, or the endogenous development policy. Regional development policy strategies partly borrow from economic theories in other fields, such as growth theories and theories of economic development. However, regional policies embody also additional micro-economic and spatial aspects which are original to the regional economic discipline.

Regional policy in Britain has been faced by two specific problems. Firstly successive governments have tended to set multiple objectives for a region policy to achieve. The setting of multiple objectives is risky since a policy may fall between different schools. The Government's regional productivity paper defines it's objective as improving the performance of every region in order to achieve high and stable levels of growth and employment (HM Treasury, 2001) as measured by output per worker. Policies that merely concentrate on growth using a single target indicator may only be looking at part of the development problem. Secondly, there has been a deep-seated tension between the economic and social objectives of regional policy. Economists refer to this tension in terms of

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[17] New economic geography approaches are fundamentally different from neo-classical approaches. They draw on the tools of microeconomic analysis and new approaches to the analysis of situations of imperfect competition in where there are significant economies of scale and externality effects.

[18] Due to its cross-disciplinary nature, regional development is difficult to define. Regional development is perhaps best viewed as a holistic process whereby the environmental, economic, social and cultural resources of a region are harnessed for sustainable progress in ways that reflect the comparative advantages offered by a particular geographic area.

the possible conflict between efficiency and equity goals. The possibility that the catching up process may be characterised by a trade-off between equity and efficiency remains a controversial issue in economics. An early formation of the potential trade-off between national and regional development was provided by Williamson (1965), who drew on the work of by of authors such as Kuznets (1955), Myrdal (1957) and Hirschman (1958) to argue that the relationship between national growth and regional disparities typically takes the form of an inverted U curve[19]. Geographer and development economists have long recognised that the relationship between national and regional development maybe a non-linear relationship which has been formalised via theoretical advances in mainstream economics, notable new endogenous growth theory and the new economic geography.

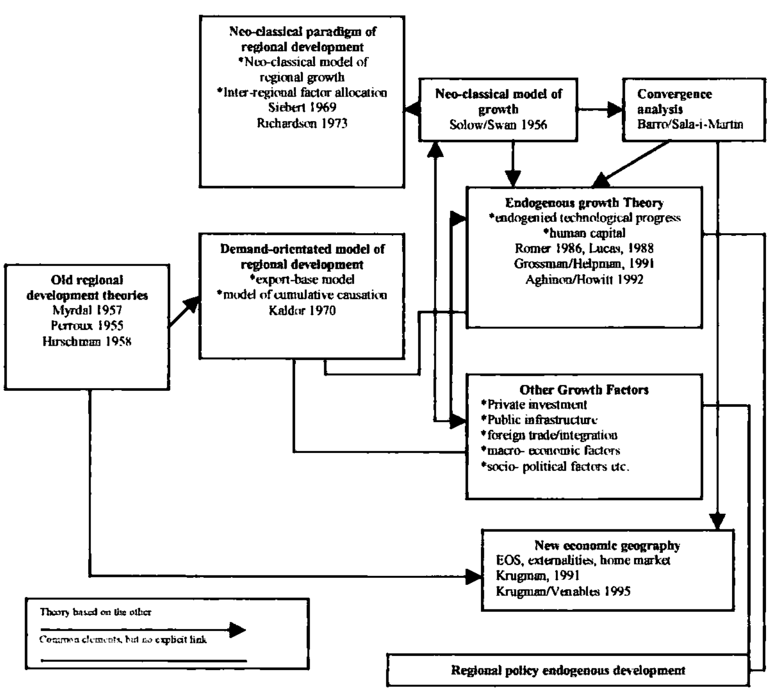
The tension between the policy objectives of national growth and regional equity has been explored empirically by de la Fuente (1996) who points out that the equity/efficiency trade-off for Spain in 1981-90 on the baseline of an estimated production function including public investment. He shows that an extremely redistributive policy of public investment would have reduced inequalities by 13.54% compared to baseline, at the expense of a 1.62% decrease in national GDP. The alternative extreme of policy orientated solely towards efficiency, and allocating public investment according to profitability would have increased GDP by 1.58% and regional disparities by 18.29%. It is important to note some critical remarks in relation to any normative interpretation of the Williamson hypothesis. One reason for the inverted U shaped curve is that central government policies in an early phase of catching up are assumed to be orientated towards agglomerations –

[19] This hypothesis is based on the observation that catching up countries enjoy a high national growth rate often see a widening of regional disparities in terms of per capita income, as national growth tends to be driven by growth poles effects which emerge in capital cities and other major agglomerations. As national growth proceeds, however, regional disparities are hypothesised to fall due to *inter alia* to spread effects.

whilst a normative interpretation of the curve simply provides an ex-post justification for these polices. Furthermore, not all regional policy projects can be classified as benefiting either the centre alone, or the periphery alone as many types of investment for example human capital may benefit both regions. Finally there is scepticism on the capacity of the regional policy to direct the process of regional development not least because policy intervention may be outweighed by other regional location factors, such as preipherality which policy can only impact to a limited extent.

The major theoretical schools and approaches, which either explicitly or indirectly explain the phenomenon of regional growth differences, will now be examined more closely in relation to Figure 1. It will become self-evident how diverse theoretical approaches are that lend themselves to explaining regional growth differences, as well as the various economic disciplines which contribute to this research.

Figure 1: Major theories in the explanation of regional growth



Source: Tondl, G (2001) Convergence after Divergence? Regional Growth in Europe pg. 23

Each theoretical school and approach detailed in Figure 1 above will be explored in detail in the following sections of this chapter so as to provide an explanation of regional growth differences and how the various theories and approaches are interlinked and how they have developed over time.

2.1.1 Old Regional Development Theories

Perroux (1955) developed the concept of growth poles which indicated that development has been bought about by a certain concentration (also known as agglomeration[20]) of economic activities in an abstract space. Thus Perroux's growth pole model is a concept which considers spatially unequal growth through agglomeration forces. The growth pole hosts a propulsive industry, i.e. a large scale, technologically advanced industry with a strong innovation capacity and a potential to generate growth in linked industries. By the 1960s the growth pole concept had raised academic interest, practical strategies based on the growth pole concept, such as "growth pole strategies" emerged (for an in-depth review of the growth pole concept see Parr, 1999). Hirschman (1958) attempted to conceptualise the growth pole theory as a regional planning strategy. In his eminent book *'The Strategy of Economic Development'* Hirschman advocated an unbalanced growth strategy like Perroux. Hirschman saw development as a "chain of disequlibria". He mentioned Scitovsky's (1954) notion of inter-action and argued that development was a lengthy process during which interaction of the kind described by Scitovsky takes place not only between two industries, but up and down and across the whole of an economy's input-output matrix. In addition, Hirschman (1958) argued that in practice such concentration (i.e. growth poles) should be located in large cities. He focused on intermediate and basic

[20] An agglomeration constitutes a concentration of economic activity in space. Large agglomerations may comprise several regions of a country, or may constitute an area comprising more than one country's regions. A small agglomeration in contrast would correspond to an industrial district.

industries, rather than high industrial complexes, since they would induce greater backward and forward linkage effects. Hirschman assumed a simple model for this discussion, and he set the "North" as the growing region and the "South" which indicated underdeveloped regions. Within this model, Hirschman expected "trickling down" and "polarization" effects: "the growth of the North will have a number of direct economic repercussions on the South, some favourable, others adverse" (Hirschman, 1958). Hirschman showed that in the long run the trickle down effects have been more prevalent than the polarization effects thus reducing regional disparities. He explained that this trend is inevitable because of agglomeration diseconomies. He also showed that trade and factor mobility would automatically reduce regional income disparities[21]. Gore (1984) pointed out that Hirschman attributed this compensation mechanism to a certain level of state intervention which was an integral part of Hirschman's unbalanced strategy. In Hirschman's (1958) growth pole strategy, state intervention cannot concentrate only on making agglomeration economies but should be attached to a supplementary policy such as building residential satellite cities around the growth pole, investment in service infrastructure in rural areas, establishment of an appropriate transport system in a whole country thus reducing the tensions or pressures for polarization.

By the early 1970s most governments abandoned growth pole strategies on the grounds that firstly they were inefficient and secondly because of a change in ideology[22] (Lasuen, 1969). Richardson *et al.*, (1975) argued that growth pole strategies were misconstrued and mistreated in their application.

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[21] Based on how fast growth areas reach capacity.

[22] Since the 1970s the development of purpose was changed to consider more the eradication of poverty and the development of small cities. This change should not be seen as an abandonment of the analytical framework of the growth pole theory, rather than the abandonment of the idea of the growth centred development. Indeed, there can be a growth pole strategy for rural development, e.g., agropolitan development.

In 1957, Gunnar Myrdal developed the model of cumulative causation with which Kaldor's (1970) model partly overlaps. Myrdal (1957) stressed that economic activities show a tendency to cluster in spaces, so that agglomerations appear. This happens because of increasing internal and external economies in agglomerations. Internal economies of scale associated with the clustering of production correspond to the economies of scale envisaged in Kaldor's model. Myrdal also considers externalities which can accrue in agglomerations. He argued that trade and factor mobility has backwash effects on other underdeveloped regions, so that poorer regions become poorer in the development process i.e. the reverse of Hirschman. He also mentioned side effects which diffuse the technology and innovation to other regions. The similarities between these three models are that they share features of increasing returns.

2.1.2 Neo-classical model of growth

The concept of convergence has its roots in the neo-classical model of growth, and is referred to as the Solow model of growth (a macro model), based on the work of Robert Solow (1956) and Trevor Swan (1956). The central characteristics of the neo-classical model of growth are the assumptions that (i) the level of technology is exogenously determined, (ii) the production function shows constant returns to scale, and (iii) the production factors labour and capital each have diminishing marginal products. The neo-classical model identifies three sources of output growth, the capital stock, the labour force and technology. Hence a region's output growth will depend upon the growth of these three factors of production.

The Solow growth model argues that the growth in output per capita is driven by technological progress; a major drawback of this model is that the causes of technological progress are not identified endogenous growth theory attempts to overcome this deficiency. In addition, the neo-classical approach to explaining regional growth disparities ignores the potential contribution of factors on the demand side of the economy. To remedy this weakness, attempts have been made to modify the neo-classical approach by allowing regions to trade with one another (Borts and Stein, 1964) and lead to the development of demand orientated models.

2.1.3 Neo-classical paradigm of regional development theory

The neo-classical paradigm rests on the neo-classical theory of growth and allocation of mechanisms as suggested by international trade theory. At a time when the belief in a neo-classical economic world led to the neo-classical model of growth on the macro-economic level by Solow and Swan in 1956, regional economists followed these ideas to formulate a neo-classical model of regional growth. For example Borts and Stein (1964), Siebert (1969) and Richardson (1973) established the neo-classical model of regional growth to explain regional income differences.

Early regional economists representing the neo-classical paradigm have argued that the mobility of one factor given immobility of the other factor e.g. mobile capital and immobile labour would enforce regional growth differences since only one region with a low capital level would receive the boost (Borts and Stein, 1964). With a neo-classical production function with diminishing marginal products of capital the effect is different.

The neo-classical model of growth was conceived to explain the growth process of a single economy; it entered regional economics without changes to explain growth differences of a set of regions. In both cases growth is explained by the same factors. However, regional economists view the technological level and the lag in technological diffusion between innovating and following regions as a major factor of regional income polarisation and not so much differences in factor endowment (Siebert, 1969; McCombie, 1988).

The neo-classical model of regional growth treats regions much like a state, Richardson (1973) is the first to criticise the neglects of specific regional features and spatial aspects. The core assumption of the neo-classical model, perfect competition is invalid in the spatial context where transport costs incur which lead to the new economic geography models. Richardson (1973) pleads to distinguish between regions and nations in growth theories and argues:

1. regions do not possess the policy instruments which a nation state does such as exchange rate policy, monetary policy, tax policy competition policy etc.
2. regions are much more open than nations, both with respect to commodity and factor flows[23];

One of the key predictions of the neo-classical model is that spatial disparities in per capita incomes will converge[24] over the long run as capital will flow from high-wage to low-wage regions and the labour will flow in the opposite direction until returns to capital and labour are equalised. The empirical evidence drawn from various studies (Barro & Sala-i-Martin,1991; 1992; Armstrong, 1995; Rey & Montouri, 1999) on the convergence process reveal that convergence in per capita incomes between regions has occurred but at a very slow rate. The model

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[23] Siebert (1969) considers that migration is a common phenomenon between closely located regions but fails with geographic distance. McCombie (1988) argues that very unequal regional sector structures (low productivity agricultural regions versus high productivity industrial regions), as found in European countries in the post-war period constituted to a misallocation of resources that initiated factor movements.

[24] The term "convergence" has had different connotations in the recent literature. In particular, three definitions of convergence have been used in empirical analysis see Chapter five, section 5.10.1.

therefore predicts correctly that there will be convergence of per capita incomes over the long run but the empirical studies reveal that it is likely to be painfully slow.

The neo-classical approach has undergone various improvements and modifications but still suffers from serious weaknesses. As highlighted by Armstrong *et al.*, (2000) such as investors and workers are assumed to be perfectly informed about factor prices in all regions and to respond to any regional differentials by migrating to the region offering the lucrative rewards. But neither investors nor workers are perfectly informed and there are significant impediments to this market response to factor price differences between regions. In addition, the neo-classical models assume perfect flexibility or factor prices so that inter-regional movement in capital and labour will automatically remove factor price differences between regions. Finally the model fails to take spill-over effects from neighbouring regions into account, due to the strong trade and labour market linkages between contiguous regions (see Chapter four, section 4.10.1 for an in depth discussion).

2.1.4 Endogenous Growth Theory[25]

The proponents of the extended neo-classical growth model have developed what has become to be known as the endogenous growth model, which focuses on explaining how technical change is determined. They argue that technical progress is both the cause and effect of growth unlike the neo-classical model where technical change is not explained. The new growth theory initiated with the work of Romer (1986) rests on the central idea that a production factor must not have diminishing returns. With constant or even increasing returns, the accumulation of capital would result in constant or increasing growth rates. This would lead to lasting or even increasing regional income differences. The

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[25] Endogenous growth theory is also referred to as the new growth theory.

possibility of endogenous growth is generated by factor capital[26]. Romer (1986) examined the idea that spill-overs[27] could be associated with the accumulation of knowledge and could be strong enough to outweigh the drag caused by decreasing returns to capital to sustain growth in per capita output. There is a lively debate on the role of spill-overs of innovations in the economy and their effect on economic growth. The attention given, attempts to quantify the role of technology in spill-overs have increased considerably since their inclusion in growth models (for instance Romer, 1986; Grossman & Helpman, 1991). It is the characteristic of technological change namely non rivalry in the use of innovations (which raises the public good character issue) and the difficulties in appropriating new technology which have led to its association with spill-overs. The seminal contribution of Grilliches (1979) notes the existence of two different types of economic spill-overs: rent spill-overs and knowledge spill-overs. The former is associated with difficulties in capturing the full economic benefits of an innovation via its price, while the latter deals with flows of knowledge which are not part of an economic transaction. Rent spill-overs occur because the producer of an innovation does not charge a price that fully reflects the benefits of the innovation to the user. As a result productivity improvements accrue to the user firm from the R&D expenditure of the producer firm at zero marginal costs.

Knowledge spill-overs relate to the production of knowledge that has public-good characteristics limiting the ability of the firm to stop another firm (person), exploiting it. Not all knowledge falls into this category: some may be private and easily appropriated by the firm. Knowledge transmitted through scientific journals and via the product itself

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[26] Factor capital comprises of physical capital, human capital and the level of technology incorporated.
[27] A spill-over is an action taken by one person or firm that affects another person or firm.

(accessible through reverse engineering), and the movement of skilled personnel between firms, fall into this category. The result is that a firm may use knowledge originating in another firm without paying the full price for its benefits.

Surveys on the literature on the estimation of spill-overs (Nadiri, 1993; Griliches, 1992) generally conclude that while there is evidence that they raise productivity estimates of their importance vary generally across studies. There is a variety in the proximities chosen to measure spill-overs: R&D expenditure, patent information and innovation surveys have all been used. In addition, different estimates of the technological distance of firms from each other, and of sectors, have been used to weight this technology stock (Jaffe, 1989).

Following the work of Romer, other economists have developed models that expand the idea of endogenous growth theory whereby technological advances are generated as an endogenous process. This model begins with a slight amendment to the production function used by Solow. As noted earlier an economy's output is assumed to be determined by its capital stock, its labour force and the technical knowledge of its workers in the Solow production function, but in this case the technical knowledge is assumed to be attached to the workers themselves.

Endogenous growth theory is rooted firmly in the foundations of neo-classical growth theory. However, in traditional neo-classical growth theory, technology tends to enter the model as an unexplained, or exogenous, variable influencing growth. From the latter part of the 1980's[28] onwards, endogenous growth theory rapidly grew, generating a

[28] In tandem with these developments in high theory the 1980's saw the evolution of what came to be known as the "Washington Consensus" on development policy. Among policies linked with the consensus were devaluation, reduction of budget

large amount of theoretical and empirical research (Romer, 1986, 1990; Lucas, 1988; Mankiw *et al.*, 1992). In particular, economists have attempted to develop more realistic models in which technological change is no longer seen as exogenous, but results from investment decisions (i.e. endogenous variable).

The influential contributors of new growth theory include Romer (1986), Lucas (1988), Robelo (1991), Grossman & Helpman (1991) and Aghion & Howitt (1992). They attempted to provide an alternative concept to the steady state of growth where the neo-classical model growth is determined by exogenously given technology. In addition endogenous growth models are not all based in technology as the explanatory factor.

The principal types of endogenous growth model comprise:

1. Romer, (1986) views capital in a broad sense consisting of physical and human capital[29];
2. Aghion & Howitt (1992) and Romer (1990) model incorporate technological innovation process by introducing theories of research and development; and
3. Lucas (1988) builds on the model of Romer (1986) and adds human capital as a proper factor of production alongside with physical capital in the production function.

In all these models factor accumulation does necessarily result in diminishing marginal products.

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deficits and inflation, liberalisation of prices and interest rates and privatization. What connected these policies was the belief that governments had played an overactive role in promoting development, taking on tasks best left to the private sector, and abusing powers best left unused. Widespread government intervention was not only unnecessary to promote growth, it was the chief barrier to achieving that growth (Williams, 2001).

[29] Romer (1986), Lucas (1988) and Robelo (1991) model exhibits constants returns to scale opposed to diminishing returns. The reason for "non diminishing returns" are through learning by doing which effects knowledge spill-overs.

There has been limited application of endogenous growth theory to regions with most of the research to date concentrating on national economies. According to the advocates of endogenous growth models, regional income differences are importantly related to human resources (innovation activities, education and professional skills). In addition, there are other factors (causality) which enable endogenous growth such as certain types of public capital, which interact with private capital and enhance its productivity. Consequently the endowment of a region in these factors determines its growth path. Endogenous growth theory does not distinguish regional differences in growth drivers. Chapter three section 3.5 set will explore the regional differences in the growth drivers.

2.1.5 Demand orientated model of regional development

The potential significance of the export sector in explaining a region's growth was first investigated in depth by economic historians (Innis, 1920; North, 1955) whose work led to the emergence of the export base model[30] of regional growth. As noted earlier the neo-classical approach to explaining regional growth disparities ignores the potential contribution of factors on the demand side of the economy. To remedy this weakness, attempts have been made to modify the neo-classical approach by allowing regions to trade with other regions (Borts & Stein, 1964). This opens up the possibility that regional growth differences may be partly explained by regional differences in the growth of a region's exports. Hence the focus of a region's export sector in determining output growth, takes us towards explanations of regional growth disparities which fundamentally differ from the neo-classical approach. Kaldor (1970) stressed the importance of a region's export sector in

[30] The central proposition of the export base model is that the initial stimulus to a region's economic development can be traced, for some regions to the exploitation and export of resources. Hence the geographical distribution of natural resources may therefore help to explain why regions grow at different rates.

determining regional growth, thus rejecting explanations based on the neo-classical model.

Kaldor argued that a region's growth of per capita output is determined by the extent to which regions are able to exploit scale economies and to reap the benefits that accrue from greater specialisation. These benefits vary according to the type of productive activity in which a region specialises. Some sectors are more susceptible to productive gains than others. In particular the manufacturing sector is able to reap substantially greater benefits from growth than land-based activities such as mining and agriculture. This means that regions specialising in manufacturing activities are likely to benefit more from productivity gains than are regions which rely heavily on land-based activities. The central argument is that regions, which specialise in manufacturing or certain processing activities, can enjoy economies of scale and other benefits from specialisation. Through specialisation the region can realise labour productivity gains and would thus increase its competitiveness. Higher competitiveness would induce more demand for the region's product, and this output growth would feed back into productivity gains. Therefore the development process is circular and cumulative one. Kaldor's productivity gains stems from technological innovations which are geared by higher output and the consequent productivity increase due to large scale production. Formally productivity gain is treated in the Kaldor model as a Verdoorn effect, i.e. productivity growth is a function of output growth.

This model however suffers from several drawbacks (Armstrong & Taylor, 2000). First, it fails to explain the type of exports in which regions will specialise. Second, the model assumes that the export sector is the only source of regional output growth. Third, Verdoorn's law conceals an extremely complex process. In particular the ways in which an expansion of output in a region leads to an improvement in productivity growth are poorly understood and are grossly oversimplified by the Verdoorn law. Finally it ignores the consequences of output growth on a region's balance of payments.

Opponents of the neo-classical view have developed an intellectual case for divergent growth. They argue that unbalanced regional growth is persistent due to the operation of a cumulative causation process. The divergence view of income inequalities was forcefully put by Myrdal (1957)[31], who argued that once regional income disparities occur there is a strong tendency for these inequalities to be reinforced by a cumulative causation process. In 1970 Kaldor took up this theme of cumulative causation which did not only challenge the traditional neo-classical convergence view, but also provided the basis for a new case to be put for a more interventionist regional policy. Kaldor's conclusion was that government intervention is necessary if regional inequalities are to be reduced. Convergence will not occur naturally due to imperfect competition. The importance of Kaldor's work on regional disparities is that it stimulated a whole new debate about the growth process which is on going.

[31] More than 40 years ago, Gunnar Myrdal argued that economists concerned with economic growth need to accept not just that it may have a great number of causes but also that these do not work in any "linear" manner. He suggested that problems with economic growth should be examined using the concept of "circular causation" where a change in one factor would affect a number of other factors, and these changes would turn feedback on the first factor (Myrdal, 1957, p. 16). The essence of the problem such as economic growth is that "it concerns a complex of interlocking, circular, and cumulative changes (p. 14)." For Myrdal this had two implications, first it was useless to look for one predominant factor, "a 'basic factor' - as everything is cause to everything else in an interlocking circular manner' (p. 19). Second viewing economic growth in these in these terms meant abandoning the search for neat econometric models: 'the relevant variables, and the relevant relationships between them are too many to permit that sort of heroic simplification" (p. 101).

2.1.6 New Economic Geography[32]

The new economic geography literature despite its name originated wholly within economics. As originally developed by Krugman (1991), the new economic geography was an attempt to adapt international trade theory to incorporate the influence of spatial factors and transport costs in a more realistic manner. The resulting 'new trade theory' or 'new economics development' quickly led to theoretical models based on the new economic geography being developed for various other geographical phenomena such as central place systems of retail centres and the historical patterns of industrial clustering in the USA and Europe (Martin *et al.*, 1996).

The new economic geography models[33] have grown out of a set of new trade theories developed in the late 1970s and 1980s (Ethier, 1982; Krugman, 1979, 1980). Since the early 1990s the new economic geography approach has gained much attention for its arguments on centralising and decentralising forces in the geographic economic space, which would lead to convergence or divergence of regional incomes. This new economic geography literature was initiated by Krugman (1991) and Krugman & Venables (1995), bringing together the idea of agglomeration economics, as suggested by Marshall's externalities (Marshall, 1920) and cumulative causation as initially proposed by Myrdal (1957). Macro-economists define agglomerations as the concentration of economic activities of all kind of economic branches; however an agglomeration may appear as a concentration of firms belonging to a specific industry. Industrial districts as e.g. financial districts of the City of London and Frankfurt represent this type of

[32] Economic geography models wish to explain the phenomenon of economic agglomerations.
[33] These models are highly formalised, but also deliberately simplified to focus on only one or two key mechanisms such as falling transport costs over time within a context of external economies.

agglomeration. The forces behind each type of agglomeration are not completely the same.

The principal forces which according to economic geography models lead to agglomerations are:

i) Externalities;
ii) Transport costs;
iii) The home market effect[34] and economies of scale; and
iv) Monopolistic competition.

Externalities arise both at the production and at the consumer side. Those externalities found in a market place were described by Marshall (1920). In his view consumers as well as producers receive an advantage from the proximity of other consumers/producers. Following Scitovsky (1954) it has become common practice to distinguish Marshallian externalities into pure or technological externalities and pecuniary externalities. Pure externalities are linked to the process of knowledge creation (innovation, education) and comprise knowledge spill-overs and technological externalities. They arise from personal interactions and involve face to face contacts[35]. Pecuniary externalities on the other hand take place through market mechanisms and mediation of prices (Ottaviano & Puga, 1998).

Transport costs are another important reason for agglomerations. With transport costs, producers try to locate in places where they meet a large

[34] New economic geography theory has taken the 'home market effect' analysis and extended it to produce explanations for the geographical clustering of industries.
[35] For example innovating firms of a particular sector concentrate in one location, technological spill-overs happen through supply-customer relationships. Knowledge spill-overs also take place when workers change workplace. As a consequence and because of technological externalities and knowledge spill-overs firms wish to locate closer to each other. Those externalities are an important reason for agglomeration economies.

demand in order to minimize transport costs. Because of this market size effect, producers like to locate in agglomerations. The market size effect is closely connected to economies of scale (or increasing returns) which govern production[36]. Increasing differentiation of products paired with monopolistic competition in the sense of Dixit & Stiglitz (1977) and the existence of increasing returns gives rise to further agglomeration forces. Differentiated products require specialised input products and services, which are only available in a large market. Under these characteristics, location of manufacturing must not necessarily follow comparative advantages as suggested by trade theory.

In the new economic geography models, situations of either convergent or divergent growth are possible. Most of the research has tended to focus on models which predict divergent growth and hence the emergence of geographical clusters of industries which are explored in section 2.2.4.3 below.

2.1.7 Convergence analysis

The conditional convergence theory is a modern version of the neo-classical model of growth theory. The theory predicts that regional disparities will narrow over time as a result of the neo-classical convergence process. However, modern conditional convergence this theory differs from the neo-classical theory in a number of important ways. Firstly, unlike the traditional neo-classical theory there is no assumption that all regions are converging on the same run (long term) steady state equilibrium. Instead it is accepted that different regions can have different technological and behavioural parameters (e.g. different propensities to save or rates of population growth). Convergence is

[36] Modern manufacturing firms are subject to economies of scale, because of setup costs indivisibility of inputs, hence firms try to maximize their scale of production. Production is there or set where they find a large market for their products i.e. in an agglomeration.

therefore conditional on these other variables which give rise to different eventual steady states. Secondly, the convergence process is not seen as some gradual, inexorable process. Instead the convergence path is explicitly modelled, and the exogenous shocks such as the oil crisis in the 1970's, may impact on the system and drive regional disparities apart again. While eventually the neo-classical convergence forces come back into play, regions may in the meanwhile experience quite prolonged periods of widening disparities in this model.

In the early 1990s, Robert Barro and Xavier Sala-i-Martin initiated the branch of convergence research by proposing what has now become the classical theoretical concept of convergence analysis[37] in two prominent papers: "*Convergence across states and regions*" (Barro & Sala-i-Martin, 1991) and "*Convergence*" (Barro & Sala-i-Martin, 1992) with both regional and national economies in mind. Prior to the discussion of their results it is important to distinguish two different types of convergence. There are beta convergence and sigma convergence. Beta convergence occurs when poor regions grow faster than rich regions. This implies a negative relationship between the growth of per capita income (over several decades) and the level of per capita income at the start of the period. Sigma convergence is a more conventional measure of income inequality and is simply a measure of the dispersion of per capita income between regions at a given point in time. Convergence occurs in this case when the dispersion of per capita income between regions (though not necessarily between people within regions) falls over time.

In a cross sectional study of US and European regions, the initial findings of Barro and Sala-i-Martin (1991) exhibit beta convergence at a rate close

[37] Convergence studies can be broken into three broad categories: Cross-section studies for absolute or conditional convergence (Barro & Sala-i-Martin, 1991; Tondl, 1997, 1999), panel data analyses (Canova & Marcet, 1995) and analyses of intra-distributional dynamics (Fingleton, 1997, 1999; Magrini, 1999).

to 2 per cent. However the authors found that regional income convergence is weaker in Europe than the US. Moreover, it weakened significantly over the past 40 years. However, the work of Barro and Sala-i-Martin (1991) suffers from a number of drawbacks in that:

1. it shows convergence within countries and not across countries;
2. the study is largely constrained to the core EC members; and
3. convergence is regarded in the subsequent decades, 1959-60, 1960-1970 etc. and therefore cannot account for interesting trend changes which have occurred in the 1970s and during the 1980s.

One of the problems with empirical studies on the rate of convergence in per capita incomes is that they fail to take spill-over effects from neighbouring regions into account. Because of strong trade and labour market linkages between contiguous regions, for example a region's economy is likely to be affected by changes in per capita income occurring in neighbouring region. One effect of there interregional linkages is that regions tend to display similar convergence trends to their near neighbours. Rey *et al.*, (1999) showed that by allowing for these spill-over effects reduces the estimated convergence rate, though only marginally for the US states over the period 1929-94.

2.1.8 Regional policy endogenous development

Each of the above mentioned theories examined in sections 2.1.1 to 2.1.7 will evidently have differing regional policy implications. For example, in the neo-classical model of growth, policy measures are rejected on the argument that they would give false signals and disturb the self regulation of the markets. In this view, the neo-classical mechanism guarantees efficiency of allocation, and equalization of incomes (McCombie, 1988; Bröcker, 1994).

On the other hand demand related approaches of regional growth delivered an argument for regional policy strategies. The export base model of regional growth and Kaldor's model of cumulative causation led to a widely spread practice of regional policy in the 1960s and the 1970s to establish export base industries in lagging regions, and thus to initiate a development from within; consequently the importance of manufacturing. Policies stressing the importance of the creation of an export-orientated sector with capital from outside have failed in many places. The failure of such policies led to the rise of endogenous development concepts in the 1980's.

In the area of endogenous regional policy linkages with formal growth theory have remained very weak. Hence new growth theory which argued the possibility of lasting income differences was welcomed as a further support for the justification of regional policy measures to equalize incomes[38] (Brocker, 1994). Beyond serving as an argument to justify regional policies, growth theories have not been used as a theoretical basis for the design of policies despite the large literature of growth which provides rich arguments in the various policy areas and for design.

2.2 Characteristics of Regional Growth

In order to explain income and growth differences across economies, growth theory has analysed the role of various factors. Among those, the

[38] Economic growth has generally reduced inequality within a country. This has been partly as a result of redistributive tax and benefits systems, which have become so significant that they may now be causing slower growth in some countries. The availability of welfare benefits may have discouraged unemployed people from seeking out a better job; and the high taxes needed to pay for the benefits may have discouraged some wealthy people from working as hard as they would have done under a friendlier tax regime. The Government can reduce inequality through pre or post taxation but there is evidently a trade off between redistribution and efficiency.

ones which in empirical research have proven to be most relevant are business investment, public infrastructure, innovation, human capital and engagement in foreign trade (Tondl, 2001). Structural factors which affect the growth process, such as investment, pubic capital, technological change, knowledge creation etc. will be discussed individually below. It is not the intention of this section to provide an extensive discussion of all the determinants of growth in the context of theory but to simply provide an overview.

2.2.1 Investment

Models of growth such as the neo-classical growth model and the endogenous growth model all contain an element of investment to explain the growth process. For example in the neo-classical growth model, the investment and saving level in an economy determines its steady state income, whereas the endogenous growth model, states that an economy's investment can determine the rate of growth. In the 1940's the Harrod-Domar Model (Harrod, 1939; Domar, 1946) proposed the idea that GDP growth was proportional to the investment rate. Concluding, economists consider the lack of investment as an important cause of low development. When considering the literature on the impact of investment on income and economic growth it is important to note that it is extremely mixed. De Long and Summer (1991) provided strong evidence that equipment investment is a major cause of long-run growth in OECD. In a sensitivity analysis of growth factors, Levine & Renelt (1992) argue that investment has a significantly positive impact on growth. However, Levine & Renelt (1992) do not consider the possibility of endogeneity between the two variables. The conflicting empirical evidence of no - or even a negative - relationship between investment and growth, lies in the possibility of endogeneity between both variables implying that in practice growth may precede investment as opposed to the other way round. For example Blomström & Lipsey (1993) find in a set of 101 countries in the period 1965-85 that investment is a consequence of high past growth performance, raising the issue of causality.

Investment Promoting Policies & Growth

In order to promote business investment, governments use various instruments, such as investment grants (or investment tax credits), depreciation allowances which amount to capital subsidies[39]. Empirical studies which explore the impact of investment incentives on an economy's investment and growth vary considerably. For example several studies have shown that regional investment incentives can induce additional investments: Franz & Schalk (1982) and Schallk & Unitiedt (1998) for Germany, Luger (1984) for the US, Faini & Schiantarelli (1985) for Italy, Harris (1991a) for Northern Ireland. The investment impact of capital subsidies is not disputed but is heavily criticised on the basis that such subsidies fail to promote employment or even have negative effects on employment (Faini & Schiantarelli (1985) for Italy, Harris (1991b) for Northern Ireland, and Folmer & Nijkamp (1987) for Netherlands). There appears to be no unanimous agreement with regards to empirical studies on the effectiveness of investment incentives. However there is a narrow view held that investment incentives need to be assessed on their contribution to employment and to growth.

Foreign direct investment (FDI) is also considered as an investment policy which affects growth. New growth theorists consider FDI to have a special growth effect on the premise of technology and know how transfer. For example Borensztein *et al.*, (1998) analysed FDI flows from industrial countries to 69 developing countries and found that FDI constitutes relatively more to economic than domestic investment. This

[39] Capital subsidies mean that a part of a firm's investment costs are actually financed by public funds.

was because FDI transfers technology, in the sense of more advanced management techniques and production technologies. However the impact of FDI on economic growth is strongly dependent on the availability of human capital in the host country. Investments require a threshold level of human capital.

National and regional governments have increasingly engaged in attracting foreign firms by favourable tax policies and generous investment incentives. The frequent argument met against investment incentives and a preferential tax treatment relate to the misallocation of investment which would reduce global economic welfare. However this problem is more complex due to the diversity of investment decision factors and consequences are less straight forward.

Investment in the firm sector is an important factor in the growth process of a region. Theoretical and empirical arguments both suggest that a region can promote its investment by investment incentives and cutting corporate income taxes. However it is important to note that in the multi-region case with highly integrated economies the beneficial role of these instruments is unclear on the premise of creative destruction (Tondl, 2001).

2.2.2 Public capital

Several growth economists, like Barro (1990), Glomm & Ravikumar (1997) and Aschauer (1989, 1997) have focussed on the role of public capital[40] in

[40] In general public capital comprises of economic and social infrastructures. Economic infrastructures include transport such as roads, railways, airports, energy supply, and telecommunications. Social infrastructures include education, training and health. The traditional way to characterise public capital is to conceive it as a public good with the standard properties to be non-excludable and non-rival. These assumptions do not apply for many public goods as they are subject to congestion. For example everybody can receive entry to the telecommunications network, but the more people that use it the less convenient it becomes for a single user. His utility declines with the use of other people.

production and growth. Public capital can be considered as a special type of capital and thus a production input, but it enters also in a very particular relationship with private capital. It is important to note firstly that public capital is a complementary input to private capital and enhances its productivity. As a consequence, public capital can enable endogenous growth. However, on the other hand public capital requires financing through taxes, which has a contractionary effect on growth; policies to promote public investment to stimulate a region's growth have natural limits[41]. Hence the need for financing will mean that rich regions with a large tax basis automatically can afford high public investment, making it difficult for poor regions to catch up when rich regions steadily upgrade their public capital stock implying endogeneity but of the wrong kind.

One of the most prominent empirical studies in this line of growth research has been that of Aschauer (1989) which sought to explain the productivity slowdown in the US on account of a decline of public investment. Aschauer (1989) showed that public capital in the US had a significant impact on per capita output with a coefficient in the production function as high as 0.39. Consequent studies purported to show an even stronger statistically significant positive impact of public capital on per capita output (Munnell, 1990; Garcia-Mila & McGuire, 1992).

The notion of public capital is typically a macro-economic view as in economics of growth, where an aggregate production factor is considered. Public capital is a heterogeneous production factor. In regional economics the various sub categories of public capital have very specific micro-economic characteristics and effect and are explicitly considered unlike growth theory. In general public capital comprises

[41] Taxation is not a neutral instrument as it effects how people spend money.

economic and social infrastructures. Economic infrastructures include transport infrastructures[42] such as roads, railways, harbours and airports. Social infrastructures include education and training, and health. After two decades of deregulation and privatization, advanced economies possess a modern type of infrastructure such as business services (research centres, representation of interest) which are available to everyone but often provided by the private sector but with public money (Barr, 1987).

One of the key problems associated with growth studies on public capital is that most studies are macro. That is to say, given the distinctly different micro-economic features of the various categories of public infrastructures, a more micro-economic view on their impact would be more appropriate so as to evaluate the impact of more specific types of infrastructures as taken in regional development studies. Button and Pentecost (1999) provide a detailed survey on this type of study.

Despite these problematic issues it is evident from the empirical studies (Barro, 1990; Glomm *et al.*, 1997; Aschauer, 1989, 1997; Munnell, 1990; Garcia-Mila & McGuire, 1992) that the level of public capital is an important factor for economic growth. It could be further argued that lagging regions with a poor infrastructure endowment could benefit from a strategy which is underpinned by an increase in public investment, initiating growth convergence. In the context of the UK the HMT view that demand needs to be demonstrated first.

2.2.3 Technological change and knowledge creation

Innovation and human factors are considered to be important factors enabling endogenous growth. According to Romer (1993), knowledge is

[42] Most studies which intensively investigate transport infrastructure reveal contradictory results. Garcia- Mila *et al.*, (1992) found a positive growth effect in contrast Thomas (1996) could not find any positive impact on transport infrastructure on European growth.

crucial and he further points out that income and growth differences are a result of idea gaps and not object gaps i.e. physical capital accumulation. Jones (2002) further supports this argument of causality by stressing that the changes in educational attainment and the world wide increase in research intensity has accounted for 80% of US growth between the 1960s and the 1990s.

Since the mid 1980s there has been an emergence of new growth theory which attempts to explain the mechanisms of technological change and their impact of growth. Early theories in this field advocated that technological progress is linked to the accumulation of physical capital (Solow, 1960; Kaldor & Mirrless, 1967; Arrow, 1962; Romer, 1986). To others technological progress is a result of purposeful innovative activity (Romer, 1990; Grossman & Helpman, 1991). Proponents of the new growth theory consider R&D as purposeful activity which is driven by the perspective of a temporary monopoly position and that generate technological advances i.e. endogeneity. That is to say the rate at which an economy can generate technological innovations determines its growth path which is further determined by resources devoted to R&D activities and the number of research personnel (accumulation of capital). It emerges that education is an important determinant of productivity growth via the adoption of new technologies and innovation activities. Furthermore, the empirical growth literature identified a positive impact of innovation activities in high income countries such as Rodriguez-Pose (1999) who also found that innovation-prone regions show distinct characteristics as well as causality: they have a high labour participation rate, little unemployment problems, high qualification level in the labour force, local universities and colleges and little social problems.

2.2.4 Other important economic factors

In addition to private investment, public infrastructures, human capital, and innovation, there are many other important factors which are relevant to the growth process. Additional economic variables that influence growth include the macro-economic environment, trade openness, employment and sectoral/ industrial structures; these will now be briefly considered.

2.2.4.1 Macro Environment

The general macro-environment, i.e. the development on inflation, budget deficits and exchange rates, has an important impact on the growth performance. Unfortunately this is often neglected in regional policy strategies which focus on supply factors without being aware of the interference of macro economic factors. Several empirical cross country growth studies verify the importance of macro-economic factors of growth. Fischer (1993) proposes that a stable macro-economic framework is a prerequisite for growth, although not sufficient to guarantee high growth rates. Macro-economic stability results in low inflation, low budget deficits[43] and a competitive and predictable exchange rate.

2.2.4.2 Employment

It is recognised fact that if a low proportion of the population participates in the production process this reduces the feasible growth of a region. There appears to be a strong link between labour participation, and the growth performance of regions. Rodriguez-Pose (1998) in a regional cluster analysis concludes that regions of above-average growth dynamics are characterised by high participation rates and low unemployment rates, whereas less dynamic peripheral regions have a

[43] High government deficits reduce investments through crowding-out.

low participation rate, show weak employment growth and have particularly high general and youth unemployment rates.

2.2.4.3 Sectoral/ Industrial structures

Many of the early development economists (Tobin, 1985; Rostow, 1963) have stressed the importance of sectoral dominance in the process of economic development, commencing from agriculture to the industrial sector and finally becoming the service sector dominated economy ("Clark–Fisher Hypothesis"). From this perspective the sectoral and industrial sector of a region must be an important element for its growth performance and should explain regional income differences. Key proponents that have contributed to this path are Kuznets (1955), Robinson (1976), Knight (1976) and Fields (1979), who all stress that a high dominance of agricultural production is typically found in early stages of development and can be associated with low income levels, and that a rise of growth occurs when labour is driven out of agriculture production attracted by higher wages in other sectors.

The importance of the creation of an industrial sector as a basis for economic development has been emphasised in both regional economics as well as development economics. Hirschman (1958) and Kaldor (1970) for example stressed the importance of the creation of a manufacturing sector for economic development. The manufacturing sector, in contrast to agricultural production would permit economies of scale, from an export basis and thus feed growth in a circular process. Gehrke and Hagemann (1996) discuss some contributions in the literature which address the role of industrial sector structures in the growth process. They advocate the notion of a capital goods sector, which itself produces either to the final goods sector or to the investment goods sector, is key to explain the different growth paths of economies.

The issue whether specialisation in specific industries or services as opposed to sectoral diversity is more favourable for regional economic growth and development, gains new aspects with the appearance of new economic geography models. The current perception is that regional economic structures can be partly explained by comparative advantages in the sense of traditional trade theory, and partly by agglomeration effects, which comprise technological externalities and pecuniary externalities (Haaland *et al.*, 1999; Davis & Weinstein, 1996, 1999) as discussed earlier in section 2.1.6.

In the models by Ricardo (1817) and Hecksher-Ohlin (1920) the allocation of production is determined by comparative advantages (technological advantage, factor endowments natural resources) where goods are fairly standardised, which use homogenous inputs and underlie perfect competition. With perfect trade liberalisation this would result in the specialisation of regions in certain industries. Specialisation would improve global and local welfare; specialised regions should thus have a better growth performance. On the contrary if products are subject to monopolistic competition and increasing returns, agglomeration forces will dominate. Production will locate close to the market (home market effect input-output linkages), which leads to agglomerations with a diversified product structure (Krugman, 1991; Krugman & Venables, 1995; Venables 1996). Migration reinforces agglomeration as people move to where the work is. Furthermore, agglomerations are fostered if R&D for the differentiated products is effected in the place (Baldwin, 1997). In this instance, regions have become agglomerations and show dynamic growth, opposed to a diversified production structure.

In addition to the standard trade theory argument for specialisation Krugman and Venables (1996) show that specialisation of a region in the course of integration can be also modelled in an economic geography framework. By developing a stylised theoretical model of the relationship between industrial agglomeration and international trade Krugman and Venables (1996) consider the location of two industries in two countries whereby both industries are imperfectly competitive and produce goods which are used in final consumption and as intermediates by firms in the same industry. Intermediate usage creates cost and demand linkages between firms, encouraging agglomeration. With high trade barriers industry operates in both locations in order to supply final consumers. At lower trade barriers agglomeration forces dominate and each industry concentrates in a single location. Economic integration therefore induces agglomeration. The paper studies the simple dynamics of the model and demonstrates that during the adjustment process a sizeable proportion of the labour force may suffer lower real wages as relocation of industry occurs, although there are long-run gains from integration.

Venables (1998) extends the model of Krugman and Venables (1996) to a continuum of imperfectly competitive sectors and a perfectly competitive sector. He then examines what proportion of sectors will be located in each of the two regions when agglomerations occur. With just two sectors the results reveal one industry in each region, meaning that both regions have the same income levels. But with many the division need not be half and half. One region can have more industries than the other, this leading to real income differences between regions. Venables shows that there are bounds to sustainable regional differences and in the course of integration, the number of industries first rises and then declines as firms become more sensitive to cost advantages and move to lower cost locations. However because within those bounds the actual division of sectors between regions is indeterminate there are strong incentives for each region to try and secure the maximum possible number of sectors.

In Venables (1998) model, however, the degree of specialisation is less than predicted by trade theory models.

Glaeser *et al.*, (1992) and Henderson *et al.*, (1995) provide empirical evidence to assess whether regional production structures follow trade theory or economic geography models. Glaeser *et al.*, (1992) finds evidence that agglomeration growth in the US is linked to sectoral diversity, Henderson *et al.*, (1995) find support for a positive effect of sectoral specialisation. Combes (2000) in an empirical study investigates whether regional growth in French employment areas is associated with sectoral specialisation or diversity (and agglomeration effects). According to his results specialisation has often a negative effect on growth, which is more pronounced in services than manufacturing. The reason is that regional industrial specialisation exists mainly in declining, traditional industrial sectors, which show a low flexibility preventing the adaptation of its products as the sector declines. Specialisation only results in higher growth effects if it is in high tech industries, such as, computers and aeronautics. In such cases it is important for firms to share specialised inputs and significant information spill-overs can take place as firms engage in R&D. In addition, Combes (2000) based on his study points out that for services the diversity in regional activity plays an important role, in which case regions enjoy higher growth. Services typically represent monopolistic competition as they use diversified inputs and produce a variety of outputs for diverse customers. The typical examples are financial and insurance services, cultural services or specialised restaurant services.

The HMT (2001) report acknowledges that UK regions vary in their industrial composition. It is well recognised that in southern parts of the UK, service sector activities are relatively more important, whilst northern regions rely more heavily on manufacturing. The mix of different industries in a region plays a key role in influencing skills, investment and technology requirements of that region. Industrial composition is therefore likely to play an important element in understanding regional and local economic dynamics.

2.2.4.4 Inter-regional Trade

Inter-regional trade differs in one very important way from international trade and that is a region trades with other regions within the nation as well as the rest of the world. While international trade throws some light on the determinants of regional trade, there exists no explanation of regional trade specialization as research is hampered by the lack of regional trade statistics. This section in part overlaps with the previous section on sectoral/industrial structure. Here we will examine the major explanations of regional trade specialization, beginning with traditional Ricardian and factor proportions explanations (developed by HeckshER and Ohlin) followed by modern theories which examine intra-industry trade, and those originating from competitive advantage and geography models.

David Ricardo was one the most important figures in the development of economic theory throughout the 19th Century. On foreign trade, Ricardo set forth his famous theory of *comparative advantage* and what became known as the "Classical" or "Ricardian" School. Ricardian trade theory is based on comparative advantage[44] and not absolute advantage. However, Ricardian theory is unable to offer a convincing explanation of what causes a region to have a comparative advantage in a commodity. In addition, the theory considers labour to be the only factor of

[44] The original idea of comparative advantage dates to the early part of the 19th century. Although the model describing the theory is commonly referred to as the "Ricardian model", the original description of the idea can be found in an *Essay on External Corn Trade* by Robert Torrens in 1815. David Ricardo formalized the idea using a compelling, yet simple, numerical example in his 1817 book titled, *On the Principles of Political Economy and Taxation.*

production. Hence why labour productivity should vary between regions is not clear. An improvement of the Ricardian theory developed by Heckscher and Ohlin 'Factor proportions theory' aims to introduce other factors of production such as capital and also attempts to provide explanations of the causes of competitive advantage. For the simple Heckscher-Ohlin[45] theorem only two factors of production exist, labour and capital the underlying causes of comparative advantage are is the initial endowment of labour capital within each region. Both models by Ricardo and Heckscher-Ohlin are considered to be unrealistic on the premise: firstly there are not only two factors of production, and does not take into account natural resources; and secondly the assumption that labour and capital are qualitatively similar in all regions is unrealistic. Extended versions of the Heckscher-Ohlin theorem which incorporate natural resources and human capital are not sufficient (Moroney & Walker,1966; Estle, 1976; Klaasen, 1973; Horiba & Kirkpatrik, 1981) this has lead to switching to more radical explanations such as intra-industry trade, and those originating from competitive advantage and geography models.

Intra-industry trade

The origins of intra-industry[46] trade lie in the failure of perfect competition (an important assumption of the Heckscher-Ohlin theorem) to emerge in trade situations. Intra-industry trade is essentially the result of two forces: the desire of modern consumers for a wide diversity in the choice of products; and economies of scale at the level of the firm (See Greenaway and Milner, 1986 and Greenway *et al.*, 1995 for alternative variants of the basic model.)

[45] In 1933 Olin published a work that made him world renowned, "*Interregional and International Trade*". In this Ohlin built an economic theory of international trade from earlier work by Heckscher and his own doctoral thesis. It is now known as the Heckscher-Ohlin model, the standard model economists use to debate trade theory.

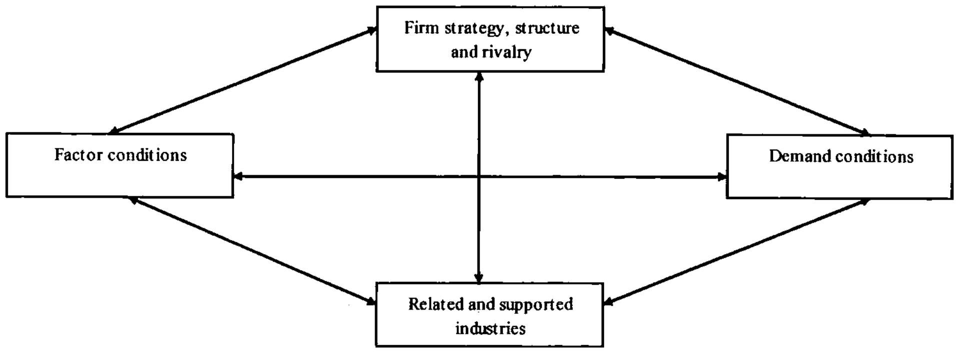
[46] Intra-industry trade between regions is when regions exchange virtually identical products. Conversely inter-industry trade is when regions are assumed to concentrate on their own distinct products which they export in exchange for different products.

According to Greenway *et al.,* (1995) there are two types of intra-industry trade:- *Horizontal* intra-industry trade when regions or countries exchange goods which are slightly differentiated from one another but roughly similar quality: and *Vertical* intra-industry trade occurs when regions or countries exchange goods within the same industry sector but where the goods are differing in quality and are drawn from different stages of the production chain. Aturupane *et al.,* (1999) in a study of intra-industry trade between EU and Eastern Europe showed 25-40 per cent of trade is intra-industry only 10-20 per cent is horizontal intra-industry trade. More interesting, the rest is vertical intra-industry trade with Eastern Europe providing cheaper intermediate goods for Western European industries. In the absence of intra-industry data it is difficult to examine the precise type of intra-industry trade that exists between regions. The rise of intra-industry trade has meant that the actual activity of production which requires the effective management of the supply chain has become more important as opposed to what is exported.

Competitive advantage

The tradition in regional economics is that in some circumstances firms can get competitive advantages over their rivals which mutually reinforce one another. The idea that firms in one region can gain competitive cost (and hence trade) advantages over their rivals in other regions by geographical clusters goes back to the work of Alfred Marshall's original work on agglomeration economies. Michael Porter (1990) revived the interest in the advantages regions and countries can gain from the clustering of industries hence no trade adjustment shift. The emphasis here is on competitive advantage, rather than comparative advantage. Porter showed that the most successful competitive advantages have been achieved when four sets of key competitiveness enhancing elements are in place. These four elements mutually reinforce one another and generate a situation of cumulative causation.

Figure 2: The determinants of competitive advantage



Source: Porter (1990)

Figure 2 summarizes Porter's explanation of why industrial clusters are able to develop and strong international competitive advantages. The interaction between the four elements must be present for strong competitive advantage. The first is the presence of favourable *demand conditions;* a strong market demand encourages the exploitation of economies of scale. The second component necessary for competitive advantage is *factor cost,* which is a much wider concept that can be developed and refined over time with specialised factors (e.g. labour with highly specific skills). The third element is *firm strategy structure and rivalry,* this part of the model stresses the need for society to create the best possible context in which firms can be created, organised and managed. It is as much to do with corporate governance as industrial structure. The final element is related to *supporting industries,* there are many advantages in firms having ready access to supply chain industries and close proximity to related industries. The key to the Porter model is the interactions existing within a region (shown by the two way arrows linking the boxes in Figure 2). It is these interactions which establish and sustain competitive advantage. Other researchers such as Kay (1996) for example, stress a combination of strategic assets (e.g. control of resource), innovativeness, reputation and industry 'architecture' (e.g. subcontracting and franchising arrangements) as key determinants of competitive advantage.

The cluster concept is not without its critiques. Amin (1999 p.370) illustrates that the experience of some of the most dynamic economies in Europe show that supply side upgrading of a generic nature e.g. advanced transport and communications systems or provision of specialised training though desirable is not sufficient to secure regional economic competitiveness. Instead in small countries such as Denmark, and successful regional economies such as Emila, Rogmana and Catalonia; policy action is increasingly centered on supporting clusters of interrelated industries which have long roots in a region's skills or capabilities base as well as a region's factor endowments which helps to secure meaningful international competitive advantage; but also reap the benefits of local specialization along the supply chain. Firm specific initiatives such as small firm development programmes or incentives to attract inward investors tend to be integrated within such cluster programmes in order to build up a system of local interdependencies. Institutional support in the form of technology transfer, training and education and access to producer services such as market intelligence, business innovation and finance tends to be sectorally specific so that help can be targeted to firms in specific clusters.

Policy has played particular attention to building economies of association within clusters, which include efforts to improve cultures of innovation within firms by encouraging local dialogue and learning based on shared knowledge and information exchange. Following translation of Michael Porter's ideas into policy action, most regions seem to have a cluster programme (as does the North East Regional Development Agency - One NorthEast). Ironically in contradiction to the institutionalist stress on **context specificity** and **path dependency**, the most common tendency beyond the selection of locally sensitive industrial clusters has been to copy from the experience of successful regions from some expert manual cluster programmes. According to Enright (1998) cluster programmes are becoming a standardized mantra as were incentive packages of preceding regional policy. Very few regions have attempted to develop unique industrial strategies based on the deep assessment of local institutional and cultural specificities. To a degree this failing stems from the inability of the policy community to recognise the centrality of softer influences such as the three considered below. Learning to adapt, broadening the local institutional base and mobilising the social economy are various forms of resource based strategies (for an in depth discussion see Amin, 1999).

2.3 Public policy

In 1997 the Government set out its central economic objective of achieving high and stable levels of growth and employment. Regional policy is at the heart of reaching this goal to reduce the persistent economic differences between and within UK regions is considered to be crucial. Regional and local growth and development is ultimately a direct function of national growth (which, in turn, is arguably a function of European and world economic growth). The Budget remains a statement of the Government's economic objectives and details the methodology that will achieve them. The 2001 Budget specifically focused on improving productive efficiency and adopts an endogenous growth theory approach offering a rationale and means for economic growth independent of trade and globalisation. Traditional theories of growth focus on trade as the engine of growth; endogenous growth theory focuses on education, on the job training and development of new technologies for the world market - which is ultimately dependent upon the choices that firms and individuals make.

In 1998 the Government introduced Public Service Agreements[47] (PSAs) targets which set the aim of making sustainable improvements in the long-term economic performance of all English regions and to reduce the persistent gap in growth rates between regions. PSAs are integral part of the Government's public expenditure framework, helping to ensure value for money from public services whereby outcomes are delivered for resources. Since 1998 the number of PSA targets have fallen from over 250 to 110 focussing on the Government's highest priorities.

The Government's regional development strategy is based on three pillars:

1) **Macroeconomic stability**, providing a stable basis to plan and invest following decades of under-investment;
2) **A regional policy framework of devolution and decentralisation** so that regions have the resources and flexibility to deliver locally led policies, within a framework of clear accountability; and
3) **Microeconomic reforms** to tackle market failures at the national, regional and local level, focused on the key drivers[48] of economic growth. Hence reduce inequalities.

Gordon Brown, in 1997 as Shadow Chancellor drew attention to Labour's interest in 'post-neo classical endogenous growth theory.' He developed this framework by focussing heavily on the 'the productivity gap' of British businesses. By identifying and encouraging the prime drivers of economic activity the UK Government decided to pursue the proponents

[47] PSAs are focussed on results and not prescribing means or process of delivery.
[48] Skills, investment, innovation, enterprise and competition.

of the endogenous economic growth model. The wider interpretation of endogenous growth theory has been given considerable attentions following the publication of a report by the McKinsey Global Institute in 1998 titled *'Driving Productivity and Growth in the UK Economy'*. The report emphasised the importance of improving productivity in the UK through reforms to the way which business and government could interface. Endogenous growth theory in part stimulates and in part derives from recognising the importance of technical drivers of change in modern economies. These changes all emphasise the increasing importance of adaptive efficiency within companies and operates policies that influence the economy.

Conclusion

This chapter has provided an overview of the major theoretical schools which either explicitly or indirectly explain the phenomenon of regional growth differences. It becomes apparent that there exist a diverse range of theoretical approaches which all aim to explain regional growth differences and influence regional policy. It should be noted that universal models of economic growth developed over the past 50 years are in their particularities and recommendations in frequent contradiction with one another. For example models have proposed limited intervention as opposed to government support for education or R&D (Rebelo, 1990; Romer, 1990), and openness as well as trade controls (Romer, 1990; Young, 1991).

Thus there is still no consensus among economists about the causes of regional growth disparities in spite of several attempts to construct models of regional growth. Recent developments in regional growth theory divide roughly into three categories: Neo-classical models stress the supply side influences on growth; Keynesian type models stress the importance of the demand for regional exports in the growth process; and cumulative causation models stress the self perpetuating nature of the growth process. Attempts have been made to incorporate the principle of self perpetuation into all growth theories, including the new growth theory based upon endogenous growth. But these models are still in their infancy and require further development if they are to prove successful in explaining regional growth disparities and in identifying determinants of growth. Recently there has been a resurgence of interest in the potential significance of external economies of scale resulting from the geographical clustering of industry and the role of these economies in the growth process.

The final section of this chapter provided a brief overview of the determinants of growth. Thereafter, the Government's perspective on UK regional policy was mapped onto the theory. It becomes apparent that the current approach to regional policy whereby identifying and encouraging the prime drivers of economic activity is embedded within endogenous growth theory. This thesis will explore whether the industrial composition of the North East region is a major explanation of it slow growth process and access whether regional inequality gaps are widening or narrowing over time.

Chapter 3: Regional Economic Development, Employment & Productivity

Introduction

In 1997[49] the Government set out its central economic objective of achieving high and stable levels of growth and employment. In order to achieve this objective the Government put in place a programme of economic reform to secure macro-economic stability, ensure employment opportunities for all and narrow the productivity gap. In a report published by the UK Treasury (2000a) titled *'Productivity in the UK: The Evidence and the Government's Approach'* the pursuit of productivity had been placed as a top priority for the UK Parliament. By increasing productivity, the Government aims to raise the UK's trend growth rate.

Since 1997 the Labour Government is seeking to sustain and increase the UK's economic growth rate and reduce inequalities by raising the economy's international competitiveness within a framework of macro-economic stability. This approach aims to improve the UK economy's efficiency[50] and competitiveness by improving the quality and the quantity of the resources - human, financial and physical - that are available in the UK.

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[49] Statement by the Chancellor of the Exchequer to the Bank of England on 6th May 1997.

[50] Efficiency and productivity are related but not identical concepts (Sharpe, 1995). A firm or industry is considered to be inefficient if it could produce more output with existing inputs, i.e. the firm is not on the production possibility curve, but within it. Productivity relates to the quantity of output produced to one or more inputs used in its production, irrespective of the efficiency of their use.

At the heart of achieving these economic objectives lie the UK regions. The framework for promoting productivity and employment across English regions is based upon two elements:

- creating an economic environment which provides a stable macro-economy and tackles market failures[51] in national and regional markets via microeconomic reforms; and
- building the capability of regional and local institutions to deal with regional and locally specific issues and deliver reforms.

In addition, HM Treasury (2000) identified five key drivers of productivity growth that underlie an economy's productivity based on endogenous growth models[52]. These are:

- Skills;
- Investment;
- Innovation;
- Enterprise; and
- Competition.

The differing performance of each of the UK's regions against the above listed productivity drivers is considered to have an impact on economic growth nationally. In the joint report by Treasury and Department of Trade and Industry (2001) titled *'Productivity in the UK 3: the Regional Dimension'*, the report set out the scale and persistence of differences in economic performance between English regions as is the intention in this chapter.

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[51] A situation in which markets do not efficiently organise production or allocate goods and services to consumers (for example, a failure to allocate goods in a way some see as socially or morally preferable).

[52] An endogenous growth macro model is one in which the long-run growth rate of output per worker is determined by variables within the model, opposed to an exogenous rate of technological progress as in a neo-classical growth model (see chapter 2 for an in-depth discussion).

The Government also introduced a number of institutional reforms as noted earlier to take forward this new regional economic agenda and tackle market failures. These include the introduction in England of Regional Development Agencies (RDAs) which are considered to be the key agents in driving forward this new regional industrial policy, and at the local level Local Strategic Partnerships. In Scotland, Wales and Northern Ireland the Devolved Administrations have been established.

This chapter will compare and contrast the North East's economic structure with that of the UK, occasionally considering other regions of the UK. In essence this chapter will consider the North East's performance against the two main determinants of growth, "employment and productivity" together with the five drivers of productivity. The measurement of productivity is also briefly discussed. The major economic and social benefits of regional policy as well as the various approaches to dealing with the causes of regional disparity such as market failure are also discussed.

3.1 Economic Growth and its Measurement

Prior to discussing the economic structure and performance of the North East economy, the importance of economic growth and how it is measured will be briefly introduced. The significance of economic growth lies in its contribution to the general prosperity of the community. The achievement of a high rate of economic growth is one of the four main objectives of macroeconomic policy[53]. Growth is desirable because it enables the community to consume more private goods and services. Growth also contributes to the provision of a greater quantity of social

[53] The four major objectives of macroeconomic policy are (i) full employment, (ii) price stability, (iii) keeping the Balance of Payments in equilibrium, and (iv) as mentioned above a high, but sustainable, rate of economic growth.

goods and services (health, education, etc.), thereby improving real living standards[54].

Economic growth is the growth of real output of an economy over time. It is usually measured in terms of an increase in real Gross Domestic Product (GDP)[55] or Gross National Product (GNP)[56] over time or an increase in income per head over time. Prior to the introduction of the 1995 European System of Accounts, the total across industries was termed 'GDP at factor cost' and this excluded all indirect taxes. When GDP was measured from the expenditure side, the total was termed 'GDP at market prices' which included indirect taxes. The difference between the two was termed the 'factor cost adjustment'. However, when the European System of Accounts was introduced in 1995 the term 'GDP at factor cost' was no longer used. It has been replaced by value-added at basic prices which is a similar concept to GDP at factor cost but not identical. Value added at basic prices excludes 'taxes on products' (mainly VAT and excise duties[57]), but does not exclude 'other taxes on production' (e.g. business rates[58]); the total across industries is termed 'Gross Value Added at basic prices' (GVA) this concept has replaced that of GDP at factor cost. Output per worker[59] is one such measure that

[54] However economic growth can also contribute to the exhaustion of finite natural resources and exacerbate problems of environmental pollution. Governments can stimulate the growth process by increasing spending in the economy through tax cuts (Fiscal policy) and by increasing the money supply and reducing interest rates (Monetary policy). Additionally they can operate on the supply side of the economy by promoting enterprise initiatives and providing resources for improving productivity and research.

[55] Gross Domestic Product: The total market value of all final goods and services produced in a country in a given year, equal to total consumer, investment and government spending, plus the value of exports, minus the value of imports.

[56] Gross National Product: GDP plus the income accruing to domestic residents as a result of investments abroad, minus the income earned in domestic markets accruing to foreigners abroad.

[57] These types of taxes are output volume related therefore output sensitive.

[58] These types of taxes are not output volume related.

[59] Output per worker is easy to calculate because the data, namely total output and employment are readily available. In addition it can be related directly to total output growth, which is equal to growth in output per worker multiplied the growth in employment.

allows us to measure productivity. Hence productivity is the main determinant of national living standards. It refers to how well an economy uses the resources it has available by relating the quantity of inputs to outputs. There are several measures of this relationship, a more comprehensive review of the various productivity measures and the problems associated with them will be considered in greater depth in Chapter four section 5.2. The economic performance of UK regions with regards to GVA is illustrated in Table 1 below.

Table 1: Regional GVA[12] (2001)

Region	Total £bn	Share of UK %	Growth on 2000 %	Per head £	Per head Index UK=100
United Kingdom[3]	851.4	100.0	4.3	14,418	100
North East	27.7	3.3	3.7	11,009	76.4
North West & Merseyside	87.6	10.3	4.2	12,942	89.8
Yorkshire & the Humber	61.9	7.3	3.8	12,459	86.4
East Midlands	55.4	6.5	3.4	13,243	91.9
West Midlands	68.8	8.1	3.5	13,031	90.4
East of England	85.8	10.1	5.0	13,909	96.5
London	140.4	16.5	5.4	22,236	154.2
South East	138.9	13.3	5.1	15,880	110.1
South West	63.6	7.5	4.0	12,873	89.3
England	730.0	85.7	4.5	14,781	102.5
Wales	33.1	3.9	3.8	11,379	78.9
Scotland	69.2	8.1	3.0	13,660	94.7
Northern Ireland	19.1	2.2	3.8	11,311	78.5

1 Data are consistent with the headline series publication on 20 Aug 2003

2 The per head series for 2001 are calculated using updated population estimates available in Aug 2003

3 Excluding Extra-Regio and statistical discrepancy

Source: Economic Trends, Office for National Statistics (ONS)

The contribution that each region makes to the overall UK GVA varies significantly. In 2001, the South West's GVA was around £63.6 billion or around 7.5% of that of all UK regions. Northern Ireland, (£19 billion) had the smallest share UK GVA at 2.2%. GVA per head of population in London was almost 35% higher than the UK average in 2001; whilst in the North East it was 24% below the UK average. Total GVA has been increasing in all regions, although there is variation in the rate of the increase between regions. The growth in total GVA between 2000 and

2001 was greatest in London (5.4%) and the South East (5.1%). The two regions with the lowest growth between 2000 and 2001 were Scotland (3.0%) and the East Midlands (3.4%).

Productive Activity (GVA)

GVA or output at current basic prices in the North East stood at £27.5bn in 2001 or 3.1% of the UK total as illustrated by Table 2. Earlier Table 1 revealed the North East region's GVA per head (11,009) was the lowest in the UK. In addition only two regions GVA per head exceeded the UK average in 2001: South East (£15,880) and London (£22,236). Table 2 show the North East region's GVA per head increased by only £1,187 (+10.9% change) between 1997 and 2001, less than half the increase seen in the UK over the same period.

Table 2: Gross Value added (GVA) at Current Basic Prices, 1997-2001 (£ million)

	1997	1998	1999	2000	2001
UK	720,692	762,963	796,273	838,065	874,227
North East	24,851	25,460	25,527	26,829	27,475
As a % of UK					
UK	100	100	100	100	100
North East	3.4	3.3	3.2	3.2	3.1
GVA per head (£)					
UK	12,390	13,075	13,616	14,291	14,852
North East	9,731	10,006	10,084	10,635	10,918

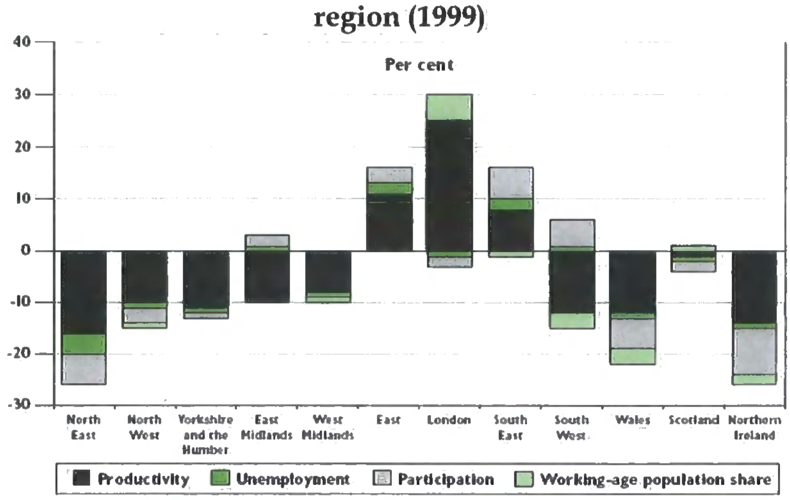
Source: Office for National Statistics

As noted in the introduction the Treasury (2000a) has identified two key determinants of growth, employment (how many people are working) and productivity (how much they produce). Prior to discussing the regional variations in these two determinants of growth, regional variations in productivity and employment are explored.

Regional variations in GDP per capita are basically functions of variations in productivity which is the output of each worker, and employment patterns which are in turn affected by the number of people of working age in an area, the proportion of those people participating in the labour market and regional unemployment rates. The relative importance of productivity and employment in contributing to regional GDP per capital varies by region as can be seen from Figure 3 below which encapsulates each of the various elements depicting the statistical decomposition of regional GDP per capita gap with the UK average.

The joint Treasury and DTI report (2001) suggests that on average productivity differentials account for 60 per cent of regional GDP per capita differentials. Variations in participation, unemployment rates and working age population account for a statistically significant proportion of regions' GDP per capita gap with the UK average. In addition both regional participation rates and working-age population shares seem to be correlated with regional productivity levels. This implies that highly productive regions attract more people who wish to participate in the labour market, hence are regions with a more flexible labour market. From a policy perspective this suggests that policies should tackle both productivity and labour market weaknesses if the Government are to successfully affect regional per capita gaps.

Figure 3: Decomposition of regional GDP per capita gap with UK average, by region (1999)



Source: Productivity in the UK 3: The Regional Dimension, DTI / HM Treasury (2001) pg. 5

It becomes evident that the relative importance of each of these factors varies across regions. In all regions, apart from Wales and Scotland, differences in productivity emerge as the largest contributor to the regional GDP per capita gap with the UK average. The economic performance in the North East, North West, Wales and Northern Ireland suffer from poor labour market performance in relation to low participation rates and high unemployment. Wales, the South West and Northern Ireland have unfavourable demographics with regards to low working-age population shares. The strong economic performance in the South East and East of England results is associated with a combination of high productivity, high participation and low unemployment. Conversely, London suffers from poor labour market performance that is high unemployment and low participation rates, but on the same hand it appears to be the richest region in the country due to its high productivity levels and high working age population. Figure 3 above shows the North East region to suffer from poor labour market performance (high unemployment and low participation rates).

3.2 First determinant of growth: employment

The joint report published by the Treasury and DTI (2001) has identified three sub components under employment whereby employment relating to the number of people working depending on:

- Demographics (the working-age population[60]);
- labour market participation rates[61]; and
- Unemployment rates.

The various sub components of employment are explored in greater depth below. In addition UK employment and output shares are briefly

[60] The working age population (defined as ages between 16-64 for men and 16-59 for women).

[61] In the UK the Labour Force Survey (LFS) divide the population of working age into three groups: people in employment, unemployed people and inactive people (those not classified as employed or unemployed).

compared with the North East according to industry groups to show the differences in national and regional employment and output structures.

Labour market participation rates

Table 3 below shows that employment rates in the United Kingdom as a whole, increased between spring 1996 and spring 2000, from 71.6 to 74.3 per cent. The South West region showed the greatest rise in employment of 3.7 percentage points whilst Northern Ireland showed a rise of only 0.5 percentage points closely followed the North East (1.4). Of the UK regions the South East shows the highest employment rate (80.6%) in 2000 as opposed to the North East (67.4%) showing the lowest. It becomes apparent from Table 3 that the overall effect was to reduce disparities between the countries[62] and regions of the UK.

Table 3: Employment rates*

Percentages

	Employment rates**				
	1996	**1997**	**1998**	**1999**	**2000**
All People					
United Kingdom	71.6	72.6	73.1	73.6	74.3
North East	66.0	66.8	66.7	64.9	67.4
North West	69.4	69.9	69.3	70.9	72.7
Yorkshire & Humber	71.4	70.5	71.9	72.5	73.5
East Midlands	74.3	75.3	76.2	75.9	76.8
West Midlands	71.0	72.7	73.8	73.6	73.1
East of England	76.0	75.9	77.7	78.1	78.3
London	68.0	70.3	69.7	71.4	71.1
South East	77.3	77.9	78.9	79.7	80.6
South West	74.9	77.1	77.7	78.1	78.6
England	72.3	73.3	73.8	74.4	75.1
Wales	67.7	68.2	67.5	68.4	69.4
Scotland	69.9	70.3	71.4	70.8	71.9
Northern Ireland	64.4	66.5	67.0	66.6	64.9

* At spring of each year, seasonally adjusted. Based on the population of working age in private households, student halls of residence and NHS accommodation. These data have been adjusted to reflect the 2001 Census population estimated.

** Total employment as a percentage of all people of working age in each region

Source: Office for National Statistics Regional Trends 36, 2001 edition

[62] Countries in this context refer to England, Northern Ireland, Scotland and Wales.

Economic activity

Table 4 below shows the South East region with the highest rate of economic activity in spring 1998 was also the same region in 2000. On the contrary Northern Ireland showed the lowest rates of economic activity in 1998 and 2000. Of the English regions the North East showed the lowest rate of economic activity. There were relatively large increases in economic activity rates in North West (2.6), Wales (1.5%) and North East (1.7). The West Midlands, East of England and Northern Ireland showed a fall in economic activity rates over time with Northern Ireland showing the greatest fall of 2.4 percentage points. In addition Table 4 shows between spring 1998 and spring 2000, economic activity rates changed little in the United Kingdom. However, disparities in rates between different areas of the UK were reduced over this period.

Table 4: Economic Activity rates*

Percentages

	All Persons		
	1998	**1999**	**2000**
All persons			
United Kingdom	78.0	78.4	78.7
North East	72.6	72.3	74.3
North West	74.2	75.7	76.8
Yorkshire & Humber	77.4	77.6	78.2
East Midlands	80.2	80.1	81.1
West Midlands	78.9	79.1	78.0
East of England	81.9	81.5	81.2
London	75.9	77.3	76.5
South East	82.6	82.8	83.4
South West	81.4	82.1	82.0
England	78.6	79.1	79.3
Wales	72.5	73.7	74.0
Scotland	77.2	76.6	77.9
Northern Ireland	72.3	71.9	69.9

*At spring of each year, seasonally adjusted. Based on the population of working age in private households, student halls of residence and NHS accommodation. These data have been adjusted to reflect the 2001 Census population estimated.

Source: Office for National Statistics, Regional Trends 36, 2001 edition

Table 5 and Table 6 briefly compare and contrast the UK and North East employment and output shares for the total economy and the manufacturing sub sectors in 2000. As noted earlier, employment and productivity are identified as the two determinants of growth, which are also inter-linked. The controversial relationship between employment and productivity is briefly discussed in section 3.3 below and explored further in depth Chapter 4 section 4.9. To this effect the share of employment and output by broad industry sector are explored briefly below.

Table 5: Total Economy Employment & Output Shares, 2000

	Employment		Output	
Broad industry groups	**NE %**	**UK%**	**NE %**	**UK%**
Agriculture, hunting & forestry	0.51	0.99	0.61	1.02
Fishing	0.02	0.03	0.07	0.05
Manufacturing	15.91	13.31	21.42	15.86
Electricity, gas and water supply	0.79	0.53	2.88	1.91
Construction	5.95	4.59	5.75	5.36
Distribution, hotels and catering	22.94	24.60	14.22	15.88
Transport, storage and communications	5.05	6.18	7.22	8.37
Financial and business services	12.91	19.84	20.98	29.15
Government & other services	35.93	29.91	26.86	22.40

Note: Constant Prices

ource: ONS

Table 5 above shows UK and North East employment and output shares in broad industry groups which makeup the total economy. It firstly becomes apparent that *Government & other services* sector account for a substantial share of employment and output in the North East which is also well above the UK average. In the UK the *Government & other services* sector accounts for the largest share of employment (29.91%) but it is the *Financial & Business Services* sector which accounts for the largest share of output (29.15%). The *Distribution, hotels and catering* sector in both the UK and North East is the second largest employer. The *Financial & Business Services* sector represents the largest share of UK output as opposed to the

Government & other services sector in the North East. The *Fishing* sector for both the UK and the North East show the smallest employment and output shares.

The *Financial and Business Services* sector the North East is 6.93 percentage points below the UK average showing the biggest difference in employment shares between the UK and the North East. In addition the biggest difference in output share between the North East and UK exist for the *Financial & Business Services* sector whereby the North East is 8.17 percentage points below the UK average. On the contrary the *Manufacturing* sector output in the North East is 5.56 percentage points above the UK average. The *Manufacturing* sector in the North East accounts for 15.91% of employment and 21.42% of output which in both instances is well above the UK average. In the five sectors *Fishing, Manufacturing, Electricity gas and water supply, Construction* and *Government and other services* the North East has output shares above the UK average.

Table 6: Manufacturing Sub Sectors Employment & Output Shares, 2000

	Employment		Output*	
Manufacturing sub sectors	**NE%**	**UK%**	**NE%**	**UK%**
Textile & clothing	5.80	7.24	3.60	4.59
Leather	0.00	0.66	0.18	0.52
Wood, paper & print	10.27	15.95	10.74	17.61
Chemical & man-made fibres	10.84	6.97	19.50	11.85
Rubber & plastic products	8.81	6.89	7.37	5.97
Non-metallic mineral products	3.26	4.02	3.10	3.93
Basic metals	18.63	14.93	14.84	12.49
Other Metals	12.05	10.56	11.57	9.45
Electronic & optical	12.90	14.53	12.08	16.73
Transport equipment	11.12	11.84	12.90	11.97
Other manufacturing	6.30	6.41	4.13	4.88

*Constant Prices

Source: ONS

Table 6 shows the employment and output shares for the UK and North East broken down into manufacturing sub sectors. In the North East the *Basic metals* sectors accounts for the largest share of employment as opposed to the *Wood, paper and print* sector for the UK. The *Chemical & man made fibres* sector accounts for the greatest share of output in the North East as opposed to the *Wood, paper and print* sector for the UK. In the four sectors *Chemical & man made fibres, Rubber & plastic products, Basic metals* and *other metals* the North East employment and output shares are above the UK average. The *Wood paper & print* sector shows the biggest employment share difference of 5.83 percentage points below the UK average between the UK and the North East. On the contrary the employment share for the *Chemical & man made fibres* sector is above the UK average by 3.87 percentage points closely followed by the *Basic Metals* sector (3.7 percentage points). When considering the output shares the *Chemical & man made fibres* sector shows the biggest output share difference of 7.65 percentage points between the UK and the North East which is above the UK average for the North East. In comparison, the *Wood paper & print* sector in the North East is below the UK average by 6.87 percentage points. The importance of industrial structure was explored in Chapter two section 2.2.4.3.

Unemployment rates

Table 7 below shows between spring 1996 and spring 2000, unemployment rates fell in all countries and regions of the UK. London experienced the largest fall (down 4.4 percentage points to 7.1 per cent). In comparison, Scotland experienced the smallest fall in unemployment (down 1.1 percentage points to 7.2%) followed by the North East (down 1.2 percentage point to 9.2 per cent). In addition Table 7 reveals that the UK region with the highest unemployment rates in spring 2000 was the North East (9.2%). Conversely the region with the lowest unemployment rate was the South East (3.4%).

Table 7: Unemployment rates*

Percentages

	Spring quarter each year				
	1996	**1997**	**1998**	**1999**	**2000**
United Kingdom	8.3	7.2	6.3	6.1	5.6
North East	11.0	10.0	8.2	10.2	9.2
North West	8.5	6.9	6.7	6.3	5.4
Yorkshire & Humber	8.2	8.2	7.1	6.6	6.1
East Midlands	7.6	6.3	4.9	5.2	5.2
West Midlands	9.5	6.9	6.4	6.9	6.3
East of England	6.2	5.9	5.1	4.2	3.6
London	11.5	9.3	8.2	7.7	7.1
South East	6.2	5.3	4.4	3.7	3.4
South West	6.5	5.3	4.6	4.9	4.2
England	8.2	7.0	6.1	5.9	5.3
Wales	8.5	8.5	6.8	7.2	6.2
Scotland	8.8	8.6	7.5	7.6	7.7
Northern Ireland	9.8	7.6	7.4	7.4	7.2

*For those of working age. Seasonally adjusted in line with the Census 2001 population estimates

Source: Office for National Statistics Regional Trends 36, 2001 edition

3.3 Second determinant of growth: productivity

An economy's output depends on two factors: how many people are working as discussed in section 1.2 above and secondly how productive they are. There are various measures of productivity such as output per worker, output per hour[63], and output per person of working age population, each measure provides a varied picture of productivity levels. For example those employed in the US and the UK tend to work more hours than in the Continental European countries. Nevertheless UK productivity however measured lags behind that of other major industrialised countries (HMT, 2000a). Narrowing the labour productivity gap is at the heart of the Government's long-term economic objective. In order to establish precise objectives for policy the Government uses output per worker as the central measure for assessing

[63] Output per hour measures the productivity of an hour of labour inputs. Its main advantage is that it is not influenced by the number of hours worked over a give period, and therefore takes account of part-time work and time not spent working.

the productivity gap. An illustration of the extent of the productivity gap is depicted in Table 8 below. Prior to the discussion of the labour productivity gap caution is advised based on the methodological issues surrounding the comparison of international statistics (for a detailed discussion see ONS, 2001). When the productivity level of the UK is set at 100 the USA is the leader of the group in relation to output per worker. Conversely France is the leader in the group in relation to output per hour worked. When comparing output per worker the UK performs much better than Germany and Japan however Germany performs 13.6% better than the UK in relation to output per hour. Compared with the UK, productivity as measured by output per worker was 13.4% higher in the G7 (excluding the UK). Table 8 shows the scale of the labour productivity gap between the UK and its international competitors' whether measured by output per worker or output per hour hence the UK Government's central objective of narrowing the productivity gap.

Table 8: International comparisons of productivity (2003)

Country	Output/GDP per worker[64] (UK=100)	Output/GDP per hour[65]* (UK=100)
France	112.9	129.4
Germany	98.6	113.6
Japan	91.9	85.0
UK	100.0	100.0
USA	128.5	119.4
G7	112.3	109.4
G7 exe. UK	113.4	110.6

* GDP per hour worked figures are experimental due to methodological issues.

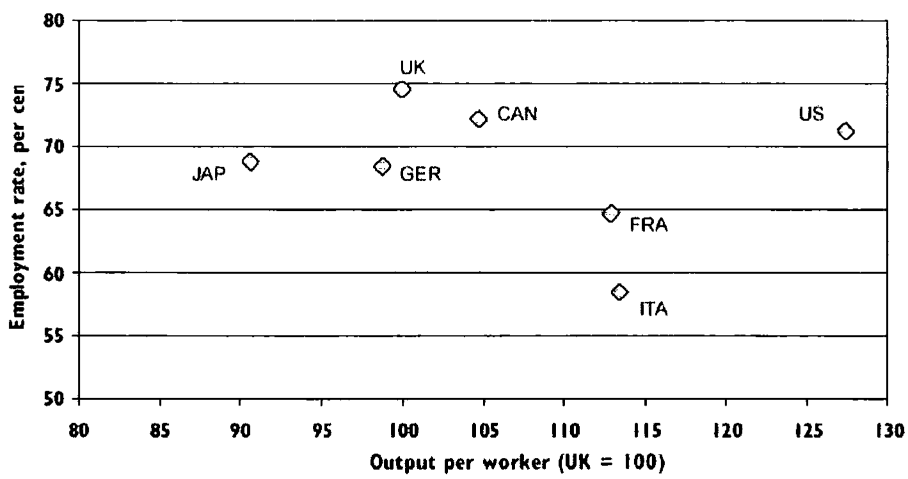
Source: Office for National Statistics[66]

[64] UK output per worker is calculated at the whole economy level only and is the ratio of Gross Value Added (GVA) at basic prices and Labour Force Survey (LFS) total employment. It includes full- time and part-time workers and is the average participation rate.

[65] UK output per hour worked is the ratio of GVA at basic prices and productivity hours worked. Productivity hours worked is calculated by multiplying the productivity jobs series at industry level by the average actual hours worked for the industry. This is derived from the Labour Force Survey (LFS). Results are scaled to ensure the whole economy productivity hours equal the appropriate LFS hours total.

The UK has a higher rate of employment than any other G7 country as depicted in Figure 4 below but the second lowest output per worker. The US depicts high productivity with regards to output per worker and high employment. Figure 4 demonstrates that is possible to achieve high levels of productivity alongside strong rates of employment like the US. One of the frequently cited explanations of the US's high productivity and employment performance is essentially due to the superior performance of the US in a wide range of Information Communication technology (ICT) producing and ICT using industries with regards to both manufacturing and the service sectors (Denis *et al.,* 2004). This is explored and discussed in greater depth in Chapter four section 4.4. Hence the challenge for the UK Government remains to boost UK labour to promote sustainable increases in productivity growth whilst maintaining strong employment in order to narrow the UK gap with the US.

Figure 4: International comparisons of employment and productivity (2002)



Source: HMT& DTI, Productivity in the UK 5, 2004, pg16

According to the Treasury's Pre Budget report (2003) UK employment is at record highs making the task of raising overall productivity (as

[66] The size of the output per hour and per worker productivity gap is currently monitored by the International Comparisons of Productivity (ICP) published by ONS.

measured by output per worker) more challenging. The challenge of raising overall productivity is embedded in the strong inter-relationship between employment and productivity. Increases in productivity are synonymous with the substitution of capital-intensive production techniques for labour leading to mass destruction of jobs. Productivity gains can lead to job losses as technological progress improves the efficiency of production processes, allowing firms to produce higher output with fewer workers. At the same time productivity gains lead to employment creation as well, since new technology also creates new products and new processes, which lead to the expansion of markets and additional job opportunities. This type of creative destruction of employment means that less productive firms will leave the market, and new more productive ones will take their place, perhaps in different industries, different sectors and even different locations. Hence the trade-offs between employment and productivity growth become apparent. Chapter four section 4.9 provides an in-depth discussion of such trade-offs.

3.4 Drivers of Productivity

As noted earlier five drivers of productivity are set out in the *"Productivity in the UK: The Evidence and the Government's approach"* published alongside the 2000 Pre-Budget report. The purpose of these productivity drivers is to provide an intellectual framework for analysing the underlying factors that are driving productivity performance and organising policies designed to improve productivity. In 1999 the UK's Department for Trade and Industry, first published the 'UK *Competitiveness Indicators'*. The UK Government was one of the first EU governments to put competitiveness at the centre of economic policy making. The report sets 38 benchmark indicators grouped under the five productivity drivers which are assessed against the relative performance of the UK's main competitors. It is worth noting that the indicators have been chosen on the basis they have "a strong relationship with competitiveness" and are the "main drivers of productivity".

3.4.1 Skills

There is a well-established relationship between improvements in skills and increased productivity, supported both by theoretical and empirical research. Growth theory suggests that human capital is one of the prime determinants of labour productivity (Becker, 1975; Mankiw *et al.*, 1992; Benhabib & Spiegel, 1994; Aghion & Howitt, 1998; Temple, 2000; Bassanini & Scarpetta, 2001). Human capital is increased both by formal education and training and learning–through–doing. Growth is centrally driven by the accumulation or stock of human capital which also, through the embodiment of technical knowledge, provides a basis for innovation (HM Treasury, April 2002, '*Developing Workforce Skills: Piloting a New Approach*'). According to various studies the variation in the skills composition of UK regions is argued to be a major factor in explaining regional variations in productivity (Blackaby & Murphy, 1991, 1995; Harris & Trainor, 1997; Campbell *et al.*, 1999).

According to Cassen and Mavrotas (1997) and Laplagne & Bensted (1999) skilled workers can often adapt faster and more effectively to change and may be better at implementing new investments and innovation. The impact of skills on productivity also works partly though the effects on capital investment levels. This mechanism was noted by the Confederation of British Industry - Trades Union Congress (CBI-TUC) Investment Group in their submission to the Government's Productivity Initiative in 2001. Evidence suggests that having highly skilled workers helps firms gain the full rewards of new investment, and thus increases the likelihood that investment will occur (OECD, 2001, '*The Growth Project.*')

Furthermore O'Mahony (1999) and Layard, *et al.,* (2001) examined the causes of international productivity performance differences and found that differing levels of skills play an important role where estimates have been presented. This suggests that between half and all of the UK productivity gap with Germany can be explained by skills differences.

Skills Supply & Demand

According to the *North East Labour Market Study* (NELMS) (2002), prepared as part of the North East Regional Skills Network project the North East region has a 'low skills equilibrium[67]' where both supply and demand for labour tends towards the low and unskilled end of the spectrum (State of the region report, 2003). In addition the NELMS (2002) highlights the need to increase the overall demand for labour in the region and significantly increase the skills demanded by employers. The report further highlights that the North East is at or near the bottom of most league tables of the objective labour market indicators[68] performing poorly compared to national average, and relative to its regional counterparts.

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[67] Market failures which affect training and skills can be broken down into two categories: General market failures which affect levels of investment in training regardless of the level of human capital in the economy, including failures in the labour and credit markets, information failures and social externalities and; a more specific set of market failures relating to the interaction between supply and demand for skills at certain skill level, which can cause economies to be trapped in a 'low skills equilibrium.'

[68] The International Labour Organisation (ILO) launched the Key Indicators of the Labour Market (KILM) in 1999 to complement existing data collection programmes and to improve dissemination of data on the key elements of the world's labour markets. There are 20 KILM indicators: Labour force participation rate; Employment-to-population ratio; Status in employment; Employment by sector; Part-time workers; Hours of work; Informal sector employment; Unemployment; Youth unemployment; Long-term unemployment; Unemployment by educational attainment; Time-related underemployment; Inactivity rate; Educational attainment and illiteracy; Manufacturing wage trends; Occupational wage and earning indices; Hourly compensation costs; Labour productivity and unit labour costs; Labour market flows; finally Poverty and income distribution.

The region further has a lower proportion than the national average in higher occupations such as managers and senior officials, professional, associates professionals and technical occupations as can be seen from Table 9. Conversely the North East has a higher proportion of employees in lower level occupations such as sales and customer service, plant and machine operatives and elementary occupations as seen from the table below.

Table 9: Occupational Groups: North East and England & Wales, 2001

Occupation groups 2001	North East %	England & Wales %
Managers & Senior Officials	11.5	15.1
Professional	9.8	11.2
Associate Professional & Technical	12.5	13.8
Administrative & Secretarial	12.8	13.3
Skilled Trades	12.3	11.6
Personal Services	7.6	6.9
Sales & Customer Services	9.5	7.7
Process, Plant & Machine Operatives	10.7	8.5
Elementary	13.6	11.9

Source: 2001 Census

Knowledge Intensity

A fundamental goal of the Regional Economic Strategy of the North East is to shift from a low skill equilibrium to a high skill equilibrium (One Northeast, State of the Region Report, 2003). The key to achieving this goal is through the creation of a new knowledge driven economy providing well paid jobs and human capital, in the form of the workforce's knowledge, skills and attributes. Knowledge intensity is measured by the proportion of graduates in the workforce. Table 10 below shows the total employment in each of the four knowledge intensity bands.

Table 10: Proportion of Graduates in the Workforce, GB Regions

	K1 Share of Total Employment	K2 Share of Total Employment	K3 Share of Total Employment	K4 Share of Total Employment
North East	11.90%	21.60%	24.90%	41.60%
North West	24.10%	22.30%	20.90%	32.70%
Yorkshire & Humberside	20.70%	20.50%	13.90%	44.80%
East Midlands	20.20%	21.30%	13.10%	45.40%
West Midlands	21.90%	22.80%	10.00%	45.20%
East of England	12.80%	33.90%	11.50%	41.90%
Greater London	55.40%	10.40%	17.30%	16.80%
South East	33.30%	21.10%	23.20%	22.40%
South West	28.30%	23.00%	13.50%	35.20%
Wales	25.80%	25.40%	10.80%	38.00%
Scotland	31.50%	16.50%	41.80%	10.10%
Great Britain	29.90%	20.60%	12.30%	37.20%

Note: total Employment excludes those who did not know their highest qualification.

K1 = sectors with over 40% of graduates

K2 = sectors with 25%-40% of graduates

K3 = sectors with 15%-25% of graduates

K4 = sectors with under 15% of graduates

Source: Labour Force Survey 2000 as given by the Local Futures Group's Regional Economic Architecture system.

The North East had the lowest share of total employment in K1 at 11.9%, 18 percentage points below the Great Britain average of 29.9%. About 33.5% of total employment in the North East is generated by relatively knowledge-intensive sectors (K1 +K2). The corresponding figure for Great Britain is 50.5%. The region had 42% of total employment in the lowest knowledge-intensity sector (K4) while the corresponding figure for GB is 37%.

The skills level of the workforce in a region (or locality) can also depend on movement of workers into and out of the region. Graduates from higher education are an important in terms of migration as they are an important source of potential high-skilled labour. Regional differences in the demand for skills are reflected in differences by skills level in the direction of migration flows. People with higher qualifications and higher ranking occupational skills are more likely to live in London and the southern parts of England as a result of selective migration

(Campbell, *et al.*, 2001). Estimates of net migration flows by level of education can be used to illustrate the process of skills re-distribution (see Table 11).

Table 11: Direction of Inter-regional migration flows by level of education, Great Britain; averages 2000- 2002

Thousands

	All Working age migration			Migrants with post school qualification		
	Out	In	Net Change	Out	In	Net Change
North East	23	16	-6.8	10	5	-4.9
North West	54	43	-10.7	27	18	-8.8
Yorkshire & Humber	49	54	5.3	21	18	-2.8
East Midlands	49	57	8.1	18	16	-2.6
West Midlands	53	48	-5.2	21	18	-3.1
East of England	65	71	5.9	21	28	6.6
London	122	93	-29.1	49	51	2.0
South East	108	117	9.2	45	52	7.2
South West	54	68	13.5	20	23	3.1
Wales	22	29	7.2	8	10	2.2
Scotland	28	31	2.7	12	13	0.9

Source: Labour Force Survey (2003)

Table 11 compares the net migration patterns of all working age people and those with post school qualifications during the period 2000-2002. The net migration figures for the total working-age population show a large net population flow out of London; population gains for all southern regions, Wales and Scotland; and a mixture of population gains and losses for the central and northern regions of England. The pattern of movements among post-school qualifications can be more simply characterised as from Northern England to the South. London was a net recipient of migrants form the rest of Great Britain at these higher educational levels.

People with higher levels of education and those working in managerial and professional and semi professional occupations are much more likely to migrate between regions (Dixon, 2003). A greater need to migrate for job reasons is an important reason for the higher mobility of more highly skilled people. In addition higher household incomes promote greater mobility on the part of the skilled. Migration has the potential to reduce disequilibria in the labour market through for example the movement of workers from areas of labour over supply to areas of demand (Dixon, 2003).

The findings of a study of the North East Graduate Labour market by Belt *et al.,* (2000) showed the North East to have a low level of graduate employment as the region is tied into a cycle of low skills, low demand for skills, low achievement and emigration of talent. The analysis revealed that graduate jobs are more prevalent in the public sectors and business services although the latter group is under represented in the region. In addition the nature of the regions problem can be seen in manufacturing where only one quarter of establishments employed more than 10% if graduates in their workforce and over one third employed no graduates at all. Although the region has relatively high manufacturing employment and high productivity in certain sub groups over all it remains the combination of low skill branch plants and relatively unsophisticated Small and Medium Enterprises (SMEs), combined with a the small business service sector the region is relatively unattractive to graduates.

Qualifications & Education

Qualification levels in the North East are below the national average; around 35% of the population aged 16-74 have no qualifications. This is 6 percentage points above the England average of 29%. Overall, 35.7% of the region's population have low level skills (level 1&2) which are similar to the England average of 36%. The region falls considerably behind the English average in relation to high level skills (Level 4) with only 15% of the regional population possessing this level of qualification, approximately 5% percentage points below the England average as can be seen from Table 12.

Table 12: Qualification of population (Age 16-74), North East, 2001

	None	Level 1	Level 2	Level 3	Level 4/5
England	28.9	16.6	19.4	8.3	19.9
North East	34.7	16.9	18.8	7.3	15.0

Note: Level 1 = 1+ O Level, NVQ level1
Level 2 = 5+ O Levels, 1 A level, NVQ level 2
Level 3 = 2 A levels, NVQ level 3
Level 4 = Degree, Higher Degree

Source: State of the region report 2003

The NELMS (2002) described the North East as an economically deprived region, which in part explains the low qualification levels achieved compared with England. Whilst both nationally and within the North East, qualification levels of school leavers are rising, young people in the region still have lower educational qualifications in comparison to England. In 2001/02 the proportion of school leavers with 5 or more good GCSE passes was 44.3%; below the average for England of 51.1%. When considering Table 13 the North East, those without graded qualifications was 6.4%, 1 percentage point above the average in England.

Table 13: Examination Achievements 2001/02 North East, England

	North East %	England Average %
5 or more GCSE* A*- C grades		
Men	39.3	46.4
Women	49.6	57.0
All	44.3	51.5
No Graded GCSEs*		
Men	7.5	6.4
Women	5.3	4.3
All	6.4	5.4

* Or GNVQ equivalent

Source: State of the Region Report 2003

Furthermore female school leavers continue to perform much better than their male counterparts (Table 13). Over 10 percentage points more women than men, both in the North East and England gained 5 or more good GCSEs. When considering men and women who left school without any qualification, the North East in both instances was approximately 1 percentage point above the England average.

3.4.2. Investment

Numerous studies (Delong & Summers, 1991; Dougherty & Jorgenson, 1997; Oulton, 2000) have identified physical capital[69] as a key driver of productivity and growth; hence investment in physical capital is considered to be a key factor underlying a country's growth performance. According to O'Mahony & De Boer (2001) the UK as a whole has a relatively small capital stock compared to its major competitors. The US has 56% more capital services[70] per hour worked than the UK, France has 48% and Germany has 32% more. This shortfall has been argued to be a major explanation of the UK's relatively poor labour productivity, and reflects years of low investment in both the public and private sectors. However due to little regional capital stock or investment data available it is difficult to examine a region's comparative growth potential as well as problems surrounding the measurement. Investment in physical capital is considered to be important as it can augment the productivity of labour.

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[69] The more generic term physical capital is sometimes used to refer to any combination of infrastructural capital and natural capital --recognising that often an infrastructural improvement, e.g. a dam or road, becomes impossible to differentiate from the natural ecology within which it is embedded.

[70] Capital services weights asset types by their user costs rather than the value of the stock. In practice this amount to placing a higher weight on short-lived asset, such as ICT, which depreciates rapidly.

In addition it is widely documented and acknowledged that people in deprived communities find it more difficult to gain access to finance in order to start their own business (HM Treasury & DTI, 2001). For example, low property values make it difficult for entrepreneurs to provide collateral to secure business loans for necessary investment (Black *et al.*, 1996).

Foreign Direct Investment (FDI) also plays an important role in stimulating economic performance in an area. On average foreign-owned firms have higher productivity levels than domestic owned firms. Foreign firms tend to be more productive than UK firms, using more capital equipment and more advanced technology. A study by Girma *et al.*, (1999a) concluded that foreign firms produced around 11% more on average than domestic firms, and paid their workers 6% more even after taking into account their higher productivity. The study also suggested that contrary to popular belief, it is US firms, rather than Japanese firms, which bring the highest productivity gains to the economy.

In addition foreign owned firms are able to provide positive spill-over benefits to firms located in the same area by introducing new technologies and working practices as well as intensifying competitive pressures (Grima *et al.*, 1999a; Oulton, 2000; Grima & Wakelin, 2000). According to Table 14 manufacturing investment as a percentage of manufacturing output was highest in the North East and the North West. Between 1998 and 2000 an average of £14.9 billion a year was invested in manufacturing in the UK, representing 4.5 percent of manufacturing output and about 10 percent of total investment.

Table 14: Manufacturing investment by UK and foreign owned companies; 1998-2000 average

	Manufacturing investment in the UK (£ millions)			Manufacturing output (£ millions)	Manufacturing investment as a percentage of manufacturing output (£ millions)
	UK Owned	Foreign Owned	Total	UK & Foreign Owned	UK & Foreign Owned
North East	558	249	978	18,476	5.3
North West	2,080	485	2,564	49,966	5.1
Yorkshire & Humber	1,358	263	1,621	34,668	4.7
East Midlands	1,108	407	1,516	32,287	4.7
West Midlands	1,368	671	2,039	46,829	4.4
East of England	1,028	341	1,370	34,660	4
London	895	360	1,255	35,664	3.5
South East	1,488	706	2,194	49,323	4.4
South West	976	382	1,358	29,127	4.7
England	10859	4044	14,903	331,020	4.5

Source: Annual Business

Inquiry Table 15 below shows gross manufacturing investment by foreign & UK-owned companies and measures the attractiveness of a region to investors. The table shows trends in manufacturing investment (net capital expenditure) by both foreign and UK-owned companies between 1994 -1997. According to the *'State of the Region Profile Report'* (2003) an annual average of approximately £17bn was invested in UK manufacturing between 1994 -1997, around one third was from foreign-owned companies. Over the same period an annual average of approximately £0.9bn was invested in the North East, almost 40% of which came from foreign-owned companies. However over the period 1999-2002 there have also been a number of major dis-investments by some companies in the North East (Tyne and Wear Research and Information, press report, 2003).

Table 15: Manufacturing Investment by Foreign & UK owned Companies (£m)

	North East	UK	North East as a % of UK
Foreign Companies			
1994	227	4,172	5.44
1995	410	5,340	7.68
1996	377	5,859	6.43
1997	369	6,478	5.70
Average (1994-97)	358	5,462	6.55
UK Companies			
1994	348	9,518	3.66
1995	543	11,428	4.75
1996	608	11,977	5.08
1997	774	13,579	5.70
Average (1994-97)	546	11,626	4.70

Source: State of the Region Report 2003

In addition, historically, improvements in transport infrastructure have played a major role in enhancing economic performance. Investments in infrastructure have a direct economic effect by reducing transportation costs for firms, workers and consumers (DETR, 1999).

3.4.3 Innovation

Innovation and technical progress are important factors in determining economic growth (Griliches, 1992; 1994). Productivity growth relies on continual stream of inventions and innovations both new technologies and improved working practices. New ways of working provide a source of greater efficiency gains which enable workers to operate more effectively and providing firms with greater opportunities to use labour and capital inputs in ways which maximise their productive potential (HMT 2000a). Research by Scherer (1984) and Griliches (1996) suggests that new technologies and cutting edge production process are produced by few world leaders (companies and research institutions) in relatively few countries which are then disseminated and adopted by other firms and across other countries and regions.

According to O'Mahony (1996) innovation has accounted for around two thirds of UK economic growth in the post-World War II period. In addition according to Vanhoudt *et al.*, (2000) a majority of the UK's productivity gap with the US can be accounted for by differences in the level of innovation. Numerous studies have suggested that there are important barriers that prevent the effective dissemination of technology between countries and firms, suggesting that the spread of more innovative and efficient ideas are localised (Keller, 2000; Grima & Wakelin, 2000). Rodriguez-Pose, (2001) has argued that poor dissemination of knowledge could therefore be a key cause of a lack of convergence between countries and regions. Other studies have also shown that underperforming regions and localities have particular problems in absorbing new technologies (Rodriguez-Pose, 2001) which is likely to be a key explanation for their innovative performance. That is to say, new innovations are not always readily transferable, but need to be adapted to industry, country and region specific circumstances. For example, if technological progress requires highly skilled workers, firms in regions with a poor skills base may not be able to take full advantage of new technologies (See Caselli & Coleman, (2000) for an empirical test of this hypothesis).

A major contribution to technical progress is expenditure on research and development. In a paper for the DTI by Porter (2003), it was commented that levels of public sector investment in research and development (R&D) across the UK are very low.

> *"The UK has in the recent past invested less public sector money into R&D than most other advanced economies. And over the last decade, the UK's position on public R&D spending relative to GDP has worsened*[71]*. Recent policy changes have started to address this and the government budgets for the next years register a significant ramping up of public sector spending"*

[71] An explanation of the decline in public R&D spending relative to GDP is considered to be a consequence growth in GDP.

From Table 16 below this view becomes apparent. At this point it is important to note that regional estimates for the Government and Business sectors are derived from the ONS surveys of Government and Business Enterprises. The highest contribution of R&D expenditure by businesses was in the South East (2,964), as opposed to the lowest regional contribution in Northern Ireland (139), followed by Wales (144) and North East (164). The contribution made by Government was the lowest in the North East (2) with the highest contribution in the South West. When considering the source of funding by higher education the North East (122) showed the lowest in relation to England. When considering the regional R&D expenditure attributed by higher education in the UK, Northern Ireland (70) depicted the lowest whereas London (895) depicted the highest.

The significance of R&D expenditure lies in its explanation of the resurgence in US labour productivity growth for the period 1995-1999 (Stiroh, 2001). The resurgence in US productivity growth is explained by an increase in physical capital investment across the US economy and to a larger extent high levels of expenditure on Information and Communications Technology (ICT) equipment which in tern has led to the rapid dissemination of ICT through the US economy allowing US firms to restructure their modes of production and develop new best practice techniques thereby raising productivity growth in the wider economy (see Chapter four section 4.4).

Table 16: Regional R&D expenditure by source of funding 2000* (£m)

	Business	Government **	Higher Education Institutions
United Kingdom	**11,510**	**2,134**	**3,633**
North East	164	2	122
North West	1,451	57	287
Yorkshire & Humber	304	48	284
East Midlands	933	56	204
West Midlands	576	194	192
East of England	2,758	259	324
London	810	258	895
South East	2,964	635	515
South West	867	307	160
England	10,827	1,816	2,984
Wales	144	65	139
Scotland	400	238	440
Northern Ireland	139	15	70

* Regional GDP figures are not available at time of publication and therefore it is not possible to show R&D expenditure as a percentage of regional GDP.

** Figures include estimates for those areas of Central Government not available from the Government Survey and local authorities.

Source: ONS

In the North East businesses accounted for approximately 57% of regional R&D expenditure, higher education accounted for 42% with the government accounting for a mere 1% of the total North East expenditure. The North East has the lowest levels of business and Government R&D Investment of all English regions.

At this point it is important to be aware of certain deficiencies with regards to the data. For example the Higher Education Institutions' (HEI) regional R&D estimates are less reliable as the expenditure estimates are obtained by allocating total R&D performed by HEIs (HERD) to individual HEIs in proportion to their income from research grants and contracts. In addition an estimate of the labour force in Full Time Equivalents (FTE) is not available. Estimates are given for UK Government Office Regions (GOR). Of the 12 GOR regions the South East of England has the highest number of R&D personnel and the largest expenditure on R&D (this reflects in part the greater size of the South East). In addition at the time of publication it is not possible to show R&D expenditure as a percentage of GDP because of the unavailability of regional GDP for 2000. These figures take into account the size of the region and are unreliable in that some expenditure is credited to the head offices but may be spent elsewhere in the regions. Table 16 shows that, within the UK, the Eastern and the South East regions have the highest concentration of R&D expenditure attributed by business. For the Government sector the highest regions are the South East, the South West, London and the Eastern region, whilst for the Higher Education Sector, London, the South East and Scotland are prominent.

Public Sector Research base

HMT *et al.,* (2001) consider the transfer of knowledge between universities and business to be crucial within the modern knowledge driven economy. Knowledge transfer is about transferring good ideas, research results and skills between universities, other research organisations, business and the wider community to enable innovative new products and services to be developed. DTI aim to make the most of the UK investment in science, engineering and technology to promote the transfer of knowledge generated and held in Higher Education Institutions (HEIs) and Public Sector Research Establishments (PSREs) to the wider economy to enhance economic growth.

The North East's public sector research base is essentially its five universities as can be seen from Table 17 below. The knowledge base and expertise within the universities is a major asset for the region, however the engagement with the wider business and social communities is limited. According to the 2003 State of the Region Report published by the North East Regional Development Agency, Universities have received funding from the Higher Education Funding Council for England (HEFCE) to develop Continuing Professional Development Programme in Knowledge Transfer (CuPiD).

The UK Labour Government recognises that increasing investments in science is crucial, but there also needs to be an effective two way link between research and the market to ensure that good research becomes good business.

The UK's long term competitiveness demands increased productivity, invention and innovation and exploitation of the science and engineering base play a vital role in supporting DTI's role of driving up productivity. In addition knowledge transfer also generates a return on the investment of public funds in the science research base and also enables HEI's to offer a broader learning experience to students and researchers, enhance relevance, while preserving the core academic mission.

Table 17: HEFCE Research Funds for North East Universities, Academic Year 2003/2004

	Quality* related research	Capability** funding[72]	Total research funding
University of Durham	£17,194,632	0	£17,194,632
University of Newcastle	£25,948,268	0	£25,948,268
University of Northumbria	£793,449	£101,544	£894,994
Sunderland University	£633,347	£180,523	£813,870
Teesside University	£203,172	£238,846	£422,018
North East Total	£44,772,868	£520,913	£45,293,782

Funding is awarded to departments based on Research Assessment Exercise (RAE) rated 4,5 or 5 rated .
**Awarded to departments RAE rated 3a or 3b in the RAE

Source: HEFCE

Table 17 above shows firstly that the North East universities have been allocated £45m in research funds[73] from the HEFCE for the academic year 2003/04, 4% of all research funding for English higher education institutes. Newcastle University derived 11% and Durham University 9%

[72] Capability funding is awarded to support research in seven emerging subject areas where the research base is currently not as strong as in more established subjects. The seven subject areas are: nursing, other studies & profession allied to medicine; social work; art & design; communications; cultural studies; dance, drama & performing arts; and sports related studies.

[73] Research Assessment Exercises (RAE) demonstrates the overall quality and international standing of research performed in UK universities. The aim of the RAE it assess the quality of UK research and to inform the selective distribution of public funds for research by the four UK higher education funding bodies.

of their research grant and contract income from UK industry, slightly below the average of 12% for the top 30 UK universities by volume of research (HEFCE, 2003).

3.4.4 Enterprise

The geographical unevenness of small firm births is a well recognised phenomenon (Bryson *et al.*, 1993; Keeble *et al.*, 1994). A report published by HM Treasury (June, 2000a) described the North East region as one with a low enterprise culture. This was measured by the number of Value Added Tax (VAT) registration per 10,000 resident adult population (including economically inactive) which is used as a proxy measure of entrepreneurship. The report revealed the 5 areas with the poorest performance in the UK in terms of start-ups were located in the North East. These areas were Wansbeck, Redcar and Cleveland, Easington, South Tyneside and Blyth. This is further supported by the work of Keeble *et al.*, (1994) and Johnson & Conway (1995) and evident when considering the number of VAT registrations in the North East in relation to other regions in England as shown in the Table 18 below. At this point it is important to note the well documented (Daly, 1990; Storey, 1994) limitations of VAT registration statistics. Firstly firms are not required to register for VAT, although they may do so, until they reach the threshold level of annual turnover, currently £53,000 (from the 1st April 2001) and may de-register when their turnover falls beneath this level. Thus very small firms are excluded from the VAT data. In 1989 Bannock and Partners estimated that in 1986 only 60% of all firms were registered for VAT. Furthermore VAT registrations and de-registrations do not equate to firm births and deaths (Gibb, 2000). However despite these limitations VAT registration and deregistration are the best official guide to the pattern of business start-ups and closures. They are an indicator of the level of entrepreneurship and the health of the business population.

Table 18: Registrations and de-registrations by region 2000

No. per 10,000 resident adults	Registrations 2000	De-Registrations 2000
North East	21	20
North West	34	32
Yorkshire and Humber	30	32
East Midlands	36	35
West Midlands	34	34
East of England	43	40
London	65	61
South East	45	42
South West	39	39
England	41	39

Adapted from: Small business Service (Performance analysis Unit) 2000

In recent years there has been an increase in the volume of literature concerning the determinants of firm births and deaths. Empirical investigations have considered variations across industrial sectors (e.g. Creedy & Johnson, 1983; Storey & Jones, 1987) geographical areas within the same county (e.g. Keeble & Walker, 1994; Gusieneir, 1994) variations in either birth or death rates over time (e.g. Robson, 1993). More attention has been paid to births than deaths. Investigators such as Keeble *et al.,* (1993) examining the spatial variations in births and deaths have identified a wide range of potential influences. In a spatial analyses Keeble *et al.,* (1993) investigated 30 such influences, grouped under three broad headings as possible determinants of rates of business creation and survival. The first category of influences comprises of demand side variables[74] which attempt to gauge the importance of market forces on small firm activity rates. The second category includes supply side variables[75] which may encourage or impede new firm formation. The

[74] Demand side factors include changes in levels of population, GDP and incomes, and degree of concentrated urban demand.
[75] Supply side factors include variables which seek to measure asset availability or personal wealth, occupational structure, educational achievement, industrial structure and the extent of local unemployment.

third and final category encompasses policy related variables[76] which measure the impact of local and national government policy.

According to the Small Business Service (2001) in 2000 of the 3.7 million businesses enterprises in the UK, a majority were small (less than 50 employees). 25,000 were medium sized (50-249 employees) and almost 7000 were large (250 or more employees). Small business, including those without employees i.e. sole proprietors accounted for over 99% of business, 44% of non-government employment and 37% of turnover. In contrast, the large businesses accounted for 45% of non government employment and 49% of turnover.

Table 19 below considers the share of employment provided by SMEs; employment varies greatly from one industry to the next. When considering the share of employment in the various industry groups at least 99% of businesses in all but the electricity, gas and water supply sector were small or medium sized. When considering manufacturing 99.3% of employment is provided by the SMEs.

Table 19: UK SME share of business and employment by industry 2000

	Business	Employment	
	Total number	SME share of total employment %	Total employment (000s)
All Industries	3,722,610	99.8	22,132
A, B: Agriculture, forestry and fishing	190390	100	467
C, E: Mining/quarrying energy and water	3,720	77.2	239
D: Manufacturing	332,085	99.3	4,191
F: Construction	678,515	100	1,576
G: Wholesale, retail and repairs	536,040	99.8	4,509
H: Hotels and restaurants	157,310	99.8	1,621
I: Transport, storage and communication	228,075	99.8	1,596
J: Financial intermediation	59,040	99.4	1,080
K: Real estate, renting and business activities	826,125	99.9	3,271
M: Education	111,035	99.9	267
N: Health / social work	207,375	99.7	2,157
O: Other community, social/personal	392,900	99.9	1,159

Source: Small Business Service, 2000

[76] Policy related variables include spatial variations in the supportiveness of local authorities with regards to small business activity and the orientation of the local political party.

3.4.5 Competition

The competitive process drives productivity and economic growth through the formation and entry into new markets of new enterprises, bringing new products and processes; through improving the efficiency of existing suppliers by forcing cost reductions and encouraging enhanced product and service quality; and through eliminating inefficient suppliers.

The level of competition can be proxied in several ways such as; the rate of new business formation which indicates both the scope for and the achievement of enterprise: the level of transactions with other regions, showing the extent of economic integration and the pressures from suppliers and customers to achieve national and international standards of competitiveness. Success in sustaining and growing the output of sectors such as manufacturing that are exposed to global economic forces, is an associated indicator of the level of competition.

The evidence on the link between competition and the economic performance of regions is limited. However, higher rates of business start-up and disproportionate shares of inward investment are associated with superior economic performance (Cockerill, 2004). In conclusion, varying levels of competitive intensity across the UK may play an important role in explaining regional and local productivity differences. Firms in poorer areas and more remote areas may face less competition, and hence incentives to cut costs and innovate.

3.5 Regional variation in drivers

The previous section shows the gap between national and regional growth, focus has been specifically concentrated on the two determinants of growth as well as the five drivers of productivity. The differences in the regional performance against each of the five drivers of productivity will have an impact on a region's relative performance and provide some indication why certain regions may fall short of their productive potential. Prior to the discussion of the regional variation in the five drivers of productivity it is important to note that each of the drivers do not work in isolation but are interlinked.

The **skills** composition of the workforce varies considerable across the UK's countries and regions. Higher skilled workers are essential to both introducing and operating advanced production techniques as they are able to adapt faster to new technologies, play a key role in knowledge creation and are likely to receive training at work. Table 10 showed the North East to have the lowest share of total employment in knowledge intensive sector (sectors with over 40% of graduates) as opposed to Greater London with 55.4%. The North East region had 42% of total employment in the lowest knowledge intensity sector (sectors with less than 15% of graduates). Manufacturing **investment** as a percentage of output was the highest in the North East (Table 14). The North East showed lowest share of investment by UK and foreign owned firms in relation to its UK counterparts and the lowest manufacturing output for the period 1998-2000.

Measuring **innovation** by region is not straightforward. Expenditure on research and development is one proxy to show how much firms invest in the production or adoption of innovation. Table 16 showed the substantial variation in the amount of R&D expenditure amongst UK regions. The North East showed the lowest level of R&D expenditure by business, government and higher education institution in relation to its English regional counterparts as opposed to the South East showing the highest R&D expenditure by business and government and London by higher education institutions. Studies have shown that underperforming regions and localities have particular problems in absorbing new technologies (Rodriguez-pose, 2001) which is likely to be and key explanation for regional variations in their innovative performance. In addition new innovations are not always readily transferable as they need to be adapted to industry, country and region specific circumstances. For example if technological progress requires highly skilled workers firms in regions with a poor skills base may not be able to take full advantage of new technologies (Atkinson and Stiglitz, 1980).

Enterprise is considered to be a key driver of productivity growth in the economy. The growth of new firms is often associated with the introduction of new technologies, innovative ways of working and increased competitive pressure on other firms. There are large regional differences in business start ups (see Table 18). People in London and the South East are more likely to start a business than their regional counterparts most notably the North East. It becomes apparent that the North East has the lowest level of small business start-ups as opposed to London. One indicator of intensity of competition in a market is the rate of new business formation and the number of competitors. From the previous section it becomes apparent that the North East has low business start-ups as opposed to its regional counterparts. Since 1980 the higher start-up rates in London and the South East have increased the local business stock by more than a third, meaning more businesses per head of population and greater local competition. By contrast the North East has seen only marginal growth in the size of their business communities. These varying levels of competitive intensity across UK regions play an important role in explaining regional and local productivity differences. Firms in poorer regions may face less competition thus fewer incentives to cut costs and innovate.

There is considerable regional variation in the drivers but the North East region is consistently either at the bottom or near the bottom of the productivity driver league table which shows the North East region to be distinctly different.

Tackling the gap between regions and localities in the UK has a crucial role to play if the UK is to address the productivity gap between its main competitors. The persistent underperformance of certain regions and localities suggests that there is substantial unfulfilled potential in large parts of the country such as the North East. Tapping this potential would offer the prospect of very significant improvements, not only to the UK's overall growth but also to the regions in relation to employment rates and the overall standard of living. Since regions differ in their degree of sub-regional economic variation, the extent to which the difficulties they face are best tackled at the regional level will vary. Hence issues facing regions vary across the country therefore a regional approach to economic development is appropriate. Regional policy is the main instrument pursued to ameliorate regional disparity which will now be discussed.

3.6 Regional Policy

Regional policy attempts to correct regional imbalances in order to ensure a more even distribution of economic activities over the whole of the nation. The principal objective is to reduce regional disparity generally measured by employment and income indicators. As Keeble noted in 1976

> *"Regional policy is concerned with the existence and amelioration of regional disparities in economic prosperity and growth, notably between the relatively prosperous South East and Midland of Britain, and the economically lagging regions of Wales, Northern England, Scotland and Northern Ireland. The economic disparities which have attracted much attention over the last forty years are those of unemployment rates, per capita income and employment growth, although reference is sometimes made to labour activity rates and out -migration."* (Keeble, 1976, pp.206)

Regional imbalances of this type can attempt to be corrected through regional regeneration policy. The purpose of regeneration is to bring about lasting improvements in the economic, physical and social environmental conditions of an area which has been subject to change. Lichfield (1992, p.2) defines regeneration as a comprehensive, integrated vision and action which aims to resolve regional disparity. See Appendix 2 which illustrates the social and economic characteristics of the UK regions. Strong effective regional policy can help to accrue benefits for the unemployed, their communities and the national economy as a whole. In principle there are four specific ways to regenerate regions:

1) By reducing unemployment in areas of high unemployment through the relocation of industry; this has direct economic and social benefits (Bradley & Taylor, 1996; Robinson, 1998).

2) By reducing spatial unemployment disparities with regards to the movement of labour; this will reduce inflationary pressure[77] in the economy as a whole (McCrone, 1969; Taylor, 1997; Layard & Nickell, 1986; Jackman *et al.*, 1985).

3) By addressing unbalanced regional growth that leads to the persistence and intensification of regional problems through the process of cumulative causation[78] (Pissarides & Wadsworth, 1989; Halfacree *et al.*, 1992; Bradley & Taylor, 1996).

[77] Inflationary pressure rises because of the intense competition for skilled labour, which becomes scarce in periods of economic expansion. The consequence is a sharp increase in wage inflation as firms raise wages to attract more labour, which then leads to wage increases being transmitted to other regions.

[78] Cumulative causation is a process where places take the lead in a particular sector; acquire advantages such as a large concentration of people and increase the market for consumer goods and services, the development of transport systems and the generation of a community of skilled workers and technical know-how making their position unassailable. For these regions the process is a virtuous circle. Other places, unable to acquire such advantages are in a vicious circle in the reverse direction.

4) By reducing unemployment in areas of high unemployment; this is necessary politically in order to both attract funding[79] and subsidies and placate the electorate (Harrop, 1996).

Prior to discussing the particular policies the UK Government has pursued to regenerate its regions, it is important to be aware of the various approaches which deal with regional disparities.

3.6.1 Approaches to dealing with Regional Disparities

According to Bartik (1990) there are currently two dominant philosophies of economic development policy[80]; they are labelled the *traditional* approach and the *new wave* approach. The traditional approach emphasises job growth as the unifying goal of regional economic development policy and considers regional growth to be most enhanced by focusing on a region's export base. Attracting export-orientated manufacturing branch plants, typically owned by large corporations, is an important emphasis in traditional economic development policy. The new wave approach is more eclectic, but emphasises various forms of economic innovation as a unifying goal. The new wave approach includes policies encouraging small business start-ups and growth, technology development and business modernisation i.e. endogenous growth. Bartik (1990) argues that the traditional and new wave approaches provide policy guidance that is too vague. He points out that job growth and economic innovation occur in the private market without government intervention, and policies to pursue such goals acquire costs.

[79] The political motive for regional policy is particularly strong in the European Union (EU), where the European Cohesion Fund was created in 1991 to provide extra economic aid to the EUs low income regions to help spread the benefits of economic and monetary union to all member states (Armstrong & Talyor, 2000).

[80] Bartik (1990) defines economic policy as policies that seek to increase economic wealth of areas by providing direct assistance to businesses. Policies such as providing direct assistance to business in finding plant sites, small firm development centres, entrepreneurial training programmes, and other small business assistance; State support for applied business research programmes; industrial extension services to improve business productivity; and export assistance programmes.

Without some understanding of the likely magnitude of social benefits from job growth and innovation, it is impossible to determine rationally and allocate an appropriate size of the Government's economic development budget.

A third way of explaining regional disparities is market failure[81]. The market failure approach aims regional economic development policies at the goal of correcting private market failures (Bartik, 1990). Market failure is the failure of private markets to achieve economic efficiency[82]. According to Bartik (1990) the market failure approach has two strengths compared to the traditional and new wave approach to help understand regional economic development policy. Firstly, by focusing policy on what the private markets are unable to do allows a wise use of government resources. Secondly, the market failure approach leads to goals that are measurable. However Bartik (1990) also points out three limitations of the market failure approach. Firstly, there is no precise information of the magnitude of some non-market benefits. Secondly, the market failure approach by itself does not consider distributional effects of regional economic policies. Finally, any regional perspective on policy overlooks the benefits and costs of one region's policies against other regions.

The principal objective of the various approaches discussed earlier is to reduce regional disparities measured generally by income or employment indicators. There are broadly two different approaches to reducing unemployment in less well off areas. These are the market and the market failure approach. The market approach focuses on increasing the flexibility of local labour markets and advocates policies which

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[81] See section 3.6.2.

[82] A situation, in which no change would result in net pound benefits, summed over all member of society. If benefits exceed costs from some change, gains from trade should cause markets to facilitate the change.

remove all statutory controls that guarantee a minimum wage, reduce unemployment benefit to take low paid jobs, abandon national wage bargaining by weakening the role of trade unions and reduce the costs of hiring and firing to induce employers to take on more workers. The market failure approach (sometimes referred to as the interventionist approach) to regional policy argues that to eliminate high unemployment, it is necessary to increase the demand for labour or improve the supply of labour. The way forward in this interventionist approach is to increase the productive potential of less well off areas, policies act on either demand or supply side with the primary aim of improving market operations. Policies pursued under the market failure approach include; change in the industrial mix of the less well off areas which make them less vulnerable to change; improve the skills level of the local work force though education and training; subsidising activity in the assisted areas; encourage an inflow of investment from firms located in non-assisted areas or abroad through the provision of investment incentives; encourage indigenous development through new firm formation and the growth of small firms and entrepreneurship.

The UK Government has opted to deal with regional disparities by intervening in the market, hence pursuing those policies derived from market failure studies (Taylor & Wren, 1997, pp842). See Appendix 2 for a historic review of the UK Government's perspective on the case for regional economic policy.

Regional economic policy in the UK has in the past focussed on subsidy and failure which has resulted in persistent regional economic differentials[83]. The new regional policy focuses on policies to invest in

[83] Policy failures usually combine one or more of three types of policy failures: i) *Attempts to freeze existing patterns of economic activity*, through protectionist measures and large-scale support for failing industries; ii) *Isolated policy interventions that simply inject resources into an area* without taking into account the inter-relationships between

tackling market failures and building on indigenous strengths at every geographical level, alongside providing strong and effective institutions needed to deliver such reforms. As noted by Porter *et al.*, (2003)

> *"The UK currently faces a transition to a new phase of economic development. The old approach to economic development is reaching limits of its effectiveness and government, companies and other institutions need to rethink their policy priorities. This rethinking is not a sign of the past strategy's failure; it is a necessarily part of graduating to the new stage"* (DTI Economic Papers, No 3, *'UK competitiveness: moving onto the next stage'*)

This new regional policy rests on two principles. First it aims to strengthen the long-term building blocks of growth, innovation, skills and the development of enterprise, by exploiting the indigenous strengths in each region and city; and secondly, it is a bottom-up not top-down approach, with national government enabling powerful regional and local institutions to work by providing the necessary flexibility of resources.

3.6.2 Market Failure

Market failure as noted earlier is the failure of markets to achieve an optimum resource allocation for welfare maximisation. However many markets are subject to imperfections or failures. Market failures can occur in many different ways and for a wide range of causes. They can all, however be classed into four generic categories as follows:

1) Externalities - These are spill-over effects[84] which occur when actions by a firm or individual create benefits (or costs) that do not accrue (or are

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strategic complementariness between various factors associated with growth; and iii) Flawed design of government institutions charged with regional and local economic development, imposing polices upon an area instead of building on its indigenous strengths.

[84] The effects of an activity which have spread beyond what was originally intended (see Chapter four section 4.1.4 for an in-depth discussion).

not borne by) that firm or individual. Examples of externalities that relate to productivity include:

- **Training** – a firm cannot stop an employee changing jobs and so may not be able to recap the rewards of investment in an employee's training;
- **Public good such as infrastructure investment** – investment in areas such as transport is also subject to externalities. For example although a firm may benefit from building a road to its factory, it is likely that it will benefit other road users therefore investment will not go ahead.
- **Research and Development** – R&D often generates knowledge that is difficult to appropriate. Thus the benefits of one firm's R&D activity may be shared by other firms.

Due to spill-over effects, there is an incentive for each firm to wait for someone else to invest and then gain from their investment without committing any costs. Thus, it is left entirely to the market, although firms may tend to under invest.

2) Market power – When competition works effectively, firms innovate and set prices (in relation to resource costs) to win business. Where there is market power, however this process is hindered. Firstly firms reduce efficiency in production and set higher prices. Secondly market power shifts the dynamic incentive needed to innovate, which is essential to growth. Porter (1980) identified a variety of sources of market power such as:

i) strong buying power by firms with market power;

ii) weak competitive rivalry between firms;

iii) a lack of entry and exit by firms;

iv) a lack of product substitution on the part of consumers; and

v) weak buying power by consumers, or other firms buying from firms with market power.

3) Poor Regulation – Even though Government regulation has a clear and vital role to play in ensuring that markets operate efficiently, excessive or unnecessary Government regulation can obstruct efficient market functioning.

4) Information - A lack of information can cause problems for the efficient functioning or markets, for example:

i) If savers are unsure about the quality of the various savings products on offer, then they may be deterred from saving for their future; or

ii) If workers are not fully aware of the benefits they will gain from training they might under invest. Also if firms are worried that the government is not committed to delivering stability they might also under invest.

Regional and local markets failures are distinct from the national and international level and may persist because certain markets are not always national in scope. These markets are instead segmented to a varying degree by distance, transportation costs and other factors such as consumer tastes or preferences. Hence as a consequence market failures may lead to shortfalls in investment and human and physical capital, the adoption and creation of new technologies and best practice. The joint HM Treasury & DTI (2001) report set out a number of potential market failures that exist in the UK's countries and regions. These include market failures in:

- *Product markets* where the lack of competitive pressure can impact on efficiency and prices, and reduce incentives for innovation[85];
- *Capital markets* where gaps in provision can result in under investment in innovation and human and physical capital across all parts of the UK[86]; and
- *Labour markets* where inflexibility, low labour mobility and poor incentives to invest in human capital can restrict workers' and firms' ability to take advantage of new opportunities[87].

In addition the persistent shortfalls in productivity and employment are described as the result of coordination failures[88] which prevent under performing regions from taking advantage of the benefits of agglomerations or clustering (HMT & DTI, 2001). It is also argued that agglomerations can also exacerbate the positive and negative effects of clustering as regions become locked onto vicious or virtuous cycles which can prevent poorly performing regions and localities from taking advantage of the benefits of clustering.

The Labour Government recognises that market failures are a key cause of regional differentials which prevent the economic recovery of poorer regions and localities. Hence correcting such market failures are at the heart of improving the UK's productivity performance (HMT, 2000a). In

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[85] Efficient functioning product markets create the competitive pressure that increase the economy's output in three way: Keeping prices down, causing firms to increase output to satisfy demand for more consumers; ensuring that firms innovate as, if they do not they will lose their position in the market; and ensuring that firms conduct their operations in such a way as to minimise their costs of production - combining factor inputs in the forms of labour and capital in the most efficient way.

[86] Efficient functioning capital markets ensure that firms have adequate access to the capital they need to operate efficiently and to grow. Individuals also need access to finance in their own human capital

[87] Well functioning labour markets are not only essential to tackling the underlying causes of deprivation and inequality, but they are also vital for generating growth.

[88] In terms of wider policy processes and impacts, economic coordination failure occurs "where individuals' failure to coordinate complementary changes in their actions leads to sate of affairs for everyone that is worse than some alternative state of affairs that is also equilibrium" (Hoff 2000).

addition the framework for Government policy is to maximise productivity and economic growth based on two elements. Firstly, providing a stable macroeconomic environment and secondly, through microeconomic reforms. This new approach to economic policy recognises that productivity growth, alongside high and stable levels of employment, is central to long-term economic performance and rising living standards.

> *"The Governments productivity strategy is built around correcting market failures to strengthen the UK's performance in skills, enterprise, competition, investment and innovation – the five drivers of productivity."* Pre Budget Report 2003 cm 6042, pg 45

In a recent working paper Cockerill (2004) examines the effects of market failure on the rate of growth in the context of the English regions. In addition Cockerill (2004) identifies the types of market failure in the North East and maps them against the five drivers of growth as can be seen from Table 20 below. The paper concludes by considering the prospects for accelerating economic growth and reducing income inequality between English regions through addressing market failure.

Table 20: Market Failures mapped on Failure Types and Drivers of Economic Growth

Type of Market Failure	Growth Drivers					
	Employment	Skills	Investment	Enterprise	Competition	Innovation
Imperfect Competition	Labour market operation impeded by inadequate transport infrastructure and public realm investment		London-focus of intermediate capital providers	Sunk investments slow industrial adjustment to changing demand		Mutually damaging inter-regional competition for inward investment
Externalities	Tax and benefit system dilutes incentives to enter/re-enter labour market in the formal economy	Net social benefits from training > net private benefits to workers and to employers Low or negative net private benefits to basic skills	Net social benefits to the region > net private benefits to investors	Wider social benefits from business networks not recognised	Net external benefits from enterprise and employment not quantified and fully reflected in resource costs, prices and financial rates of return	Wider social benefits from diffusion of best practice not recognised or captured by enterprise
Information	Inadequate information on job opportunities and benefits from working in the formal economy	Lack of information on private rates of return to training	Lack of information on business opportunities Lack of awareness of region's quality of life and living cost benefits Finance community's lack of awareness of investment opportunities in the region	Lack of information on business opportunities	Product and factor markets lack full information	
Time Preference		Individuals have a high personal time discount rate. Attitude towards training is short-term and negative, associated with low education achievements and low aspirations	Requirement for short-term financial returns restricts investment		Competitive process encourages employers and workers to take account mainly of immediate, short-term benefits from jobs and investment	
Risk Preference		Risk of future skills mismatch. Individuals are risk-averse, unwilling to engage in training. Associated with low education achievements and low aspirations	Capital markets are risk-averse towards public infrastructure and neighbourhood renewal investments	Historical and cultural conditioning results in indigenous population being risk-averse towards enterprise		

Source: Cockerill, T (2004) Market Failure and Regional Economic Growth pg. 25

Conclusion

This chapter commenced by describing the 1997 Labour Government's economic objective of achieving high and stable levels of growth and employment. By increasing productivity the Government aims to raise the UK's growth trend rate. Two main determinants of growth are introduced, employment and productivity. Within the productivity determinant of growth five key productivity drivers were also introduced and conceptualised in relation to the UK regions. The primary aim is to show the significant and persistent differences in economic performance between and within UK regions. When possible emphasis has been confined to the North East whereby the economic structure of the North East was compared with that of the UK in relation to the five productivity drivers. Reducing the persistent differences in economic performance between and within UK regions is at the heart of enabling the Government to meet its central economic objective of achieving high and stable levels of growth and employment.

Section 3.6 of this chapter identified the role of regional policy which aims to reduce regional disparity and enhance economic growth. Thereafter the various approaches to dealing with regional disparities were introduced. Those being the *market* and *market failure* or the interventionist approach. The Labour Government has opted to deal with regional disparities derived from the market failure studies. The Government's strategy for achieving improved productivity is based on improving both the macroeconomic environment in which businesses and individuals operate and on reducing market failure through targeted micro economic policies. The regional policy of the past has been unsuccessful in addressing the underlying economic challenges facing lagging regions. According to Gordon Brown (2000) UK regional policy can be identified by three distinct phases. The first phase is characterised by first aid measures, assisting areas of high unemployment, the second phase is characterised by inward investment and the third current phase is captured by small firm creation and entrepreneurship. A strong regional policy is at the heart of the Government's productivity growth agenda. This is supported by a joint Public Service Agreement (PSA) target between HM Treasury, the DTI and the Office of the Deputy Prime Minister, which aims to improve performance in all English regions and to reduce the gap in growth rates between the regions. Appendix 2 has identified that European structural funds played a crucial role in the formation of UK regional policy, the formation of central regional government and Regional Development Agencies (RDAs) which are considered to be key enablers of economic growth in the regions. The new regional economic policy focuses on polices to invest in tackling market failures and building on indigenous strengths at every geographical area, alongside providing strong and effective institutions needed to deliver them such as the RDAs.

The final section of this chapter demonstrates that market failures are a key cause of regional differentials and also prevent the economic recovery of poorer regions and localities. In addition three potential market failures which exist in the UK's countries and regions were identified; product markets, capital markets and labour markets. Such market failures in these specific areas are considered to be detrimental to the overall UK economic growth and constrain productivity and employment levels in lagging regions.

Chapter 4: The Importance of Manufacturing

Introduction

In 2000 manufacturing as a share of total UK output accounted for 15.86% of the total economy and employment represented 13.31% of the total economy (see Chapter three Table 5). In the North East manufacturing accounted for a higher proportion of output (21.42%) and employment (15.91%) well above the national average. This chapter will explore the importance of manufacturing.

This chapter is divided into three distinct parts. The first part discusses the three perspectives concerned with the role of manufacturing in the economy. The first perspective argues a strong manufacturing base is fundamental to the future prosperity of the UK economy, where manufacturing is seen as an 'engine of growth'. This view emanates historically from the early work of Lewis (1954) and Kaldor (1966). The second perspective argues a strong manufacturing sector is no longer important as the UK is now a service sector economy. It is perceived that de-industrialisation has played a key role in the decline of manufacturing; therefore the theoretical implications of de-industrialisation on manufacturing will be briefly discussed. The term de-industrialisation can have two meanings, either a relative decline in the importance of manufacturing, or an absolute decline bringing with it the problems of job losses, etc. However job losses can also occur as output increases having implications on productivity. Finally, the third perspective is concerned with the renaissance of manufacturing in the post-industrial era sometimes referred to as the new economy[89]. This era is driven primarily by globalisation leading to the offshore outsourcing of manufacturing to developing economies where labour costs are much lower.

The second part of this chapter (section 4.5) will discuss the UK manufacturing productivity gap and the 1997 Labour Government's objective 'to have a faster rise in productivity than its main competitors over the next decade so that it closes the productivity gap'.

> *"The debate about the 'productivity gap' has mainly focussed on the performance of manufacturing. On the basis of output per hour worked, manufacturing productivity in the UK is 55% lower than the USA and 30% lower than in France and Germany. Total factor productivity in manufacturing, taking into account stocks of physical capital and skills is also significantly lower than in France (by 10%), Germany (20%) and the USA (43%) And whereas the manufacturing productivity in the USA increased by 41% between 1990 and 1999, the gain achieved in the UK was about half that"* (CM597, 2001-02).

This chapter will briefly review the regional economic strategy submitted by the North East Regional Development Agency with the discussion confined to manufacturing which is considered to be an important feature of the regional economy. The final part of this chapter will discuss the sectoral composition of the UK economy based on employment and productivity as well as output as cited in HMT report (2001). Thereafter, it will compare sectoral annual average growth rates for the period 1991-2000 of output, employment and output per worker, in the UK regions.

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[89] The phrase 'new economy' first appeared in Business Week in 1996. Over the past 10 years, it has come into daily use in commentary about the economy, business and finance. The new economy is sometimes used to describe growing emergent sectors, particularly telecommunications, media technology (TMT). These are contrasted with 'old economy' sectors, which include most areas of manufacturing and established retailing. The phrase has also been used to suggest that a new economy requires a new economic theory.

4.1 UK Regional policy & Manufacturing

Until the mid-1970s regional policy in the UK was almost entirely aimed at the manufacturing sector. That is to say standard capital[90] and labour subsidies[91] have never been available to service industries[92] and there has been only limited help for non-manufacturing production industries. The justification for concentrating aid to manufacturing was given in the White Paper *'Introducing Investment Incentives'* in 1966 and the Regional Employment Premium in 1967. The view expressed in the White Paper was that an increase in investment in manufacturing would provide the necessary improvements to the balance of payments which relied heavily on manufacturing. The White Paper was of the view that manufacturing industries in one part of the country were generally in competition with industries in other parts, unlike the service industries.

However, since 1966 the emphasis (in both government and academic thinking) changed towards greater parity of treatment between the manufacturing and service sectors. Such changes are evident when considering the 1983 White Paper on Regional Industrial Development as well as the Regional Studies Association's Report (1983) inquiry into regional problems in the United Kingdom. The latter report makes the recommendations that aid to services should be increased substantially and should be available for the widest range of tradeable services. These are services that can be sold at prices to cover costs and adds to economic activity in an area by exporting their output.

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90 Standard capital subsidies are investment incentives in the form of tax breaks for investments in buildings, plant, machinery and grants to firms which are popular instruments used by regional policy makers in their attempt to encourage growth in assisted areas.

91 Labour subsidies in the form the Regional Employment Premium (REP) and Selective Employment Premium (SEP) were paid to manufacturers located in the assisted areas during 1967-76 with the main aim of regional policy to create job in assisted areas.

92 Incentives for services industries were not introduced until 1973 (and upgraded in 1976) and were aimed at mobile office activities.

When considering the industrial policy instruments pursued in the late 1970's as well as the macro-economic policy in Britain since 1979, many academics have described them as both restrictive and inconsistent (please refer to Appendix 2 for policy interventions). These policy failures have been accompanied by an industrial performance that had also, not surprisingly, been erratic and had left British industry in a comparatively weak position. According to Kitson & Mitchie, (1996, 1996a) this decline in manufacturing is not based solely on the inadequate level of industrial output, investment, and capacity but also upon the inability of UK industrial managers to invest in future expansion (Driver, 1996).

The failure to implement appropriate industrial policies in practice is entrenched in two opposing strands of thinking. The first strand of thinking suggests that it is somehow regressive to be concerned about manufacturing since it is a sector which will inevitably give way to the rising service sector as supported by the quote below.

> *"...there is no adamantine law that says we have to produce as much in the way of manufactures as we consume. If it does turn out that we are relatively more efficient in world terms at providing services than at producing goods, then our national interest lies in a surplus of services and a deficit on goods".* (Nigel Lawson, Chancellor of the Exchequer, Report from the select committee on Overseas Trade, Vol. 11, Oral Evidence, London: HMSO, 1995, p.554)

The second strand of thinking argues that poor UK industrial performance had been caused by the types of interventionist measures attempted in the 1970s[93]. Interventionist measures were characterised as being corporatist, with an approach of promoting competition, which at the time was considered to be the most appropriate way to ensure

[93] Refer to Appendix 2 which considers the types of interventionist measures used.

increased efficiency and cut costs. It was anticipated this in turn would lead the way to increased market shares.

In addition from these two dominant strands of thinking there emerged a new school of thought which has developed as a result of globalisation. It is argued that the location of production is no longer seen as being important but instead it is the logistics management of the supply chain. Globalisation has played a crucial role in the development of this new perspective, which is driven by the offshore outsourcing of manufacturing to developing economies where the labour costs are much lower. These three strands are explored further below.

4.2 Manufacturing an engine of growth

There is a well established view in economics that manufacturing is 'the engine of growth", that can be dated as early as 1950's to the work of Lewis (1954) Kaldor (1966) and others. Kaldor (1966, 1967) carried out dynamic cross country econometric analysis using employment and productivity rate data from 12 OECD countries in the 1950s and early 1960's. From his findings Kaldor concluded that manufacturing was indeed 'the engine of growth': it enjoyed dynamic increasing returns to scale, absorbed labour surplus from other sectors of the economy and increased national productivity overall. Kaldor's (1966) main views are presented in the following three 'laws':

a) The faster the rate of growth of the manufacturing sector, the faster the rate of growth of gross domestic product (GDP).
b) The faster the rate of growth of the manufacturing output, the faster the rate of growth of labour productivity due to increasing returns to scale.

c) The faster the rate of growth of the manufacturing output, the faster the rate of transference of the labour from other sectors of the economy, raising productivity in other sectors as well, and in the economy as a whole. However it ignores technology in the services sector.

In a paper by Necmi (1999) published by *'Applied Economics'* Kaldor's growth analysis and conclusions were reviewed with recent cross country data (1960-1994) from countries at various levels of development. The findings supported Kaldor's original growth laws showing;

a) Manufacturing output growth rate was the exogenous variable determining both manufacturing productivity and manufacturing employment growth rates.
b) Dynamic economies of scale were exhibited by the manufacturing sector.
c) The faster manufacturing output growth, the faster was the transference of labour from the other sectors of the economy into manufacturing, and the faster was the growth in the national economy's productivity.
d) Manufacturing growth was the most dominant sector in determining the growth rate of the GDP.

Manufacturing is often considered as a necessary 'engine of growth' for an advanced economy and there is a plethora of interlocking arguments which support this proposition based on different rationales. The discussion of the various rationales will be confined to productivity as it forms the conceptual basis of this thesis.

4.2.1 Propulsive Industries

The first argument as noted earlier relates to manufacturing industries which are considered to be propulsive or dominant industries. A propulsive industry is an industry which is highly integrated in the economy and is further able to transmit growth into other sectors of the economy. One aspect of the argument is that growth in manufacturing has multiplier effects on other sectors of the economy. Growth in one manufacturing industry may transmit growth to other sectors of the economy through orders for inputs, from both manufacturing and service industries. This refers particularly to input-output or technological multipliers. Wood (1986) argues services are an integral part of the whole production system, highlighting that the internal complexity of the service sector means that service industries themselves generate demand for other services. Therefore may promote growth among firms supplying such inputs. Wood (1986) further argues that service industries purchase from manufacturing industries.

4.2.2 Income elasticity of demand

The second argument denotes that in order to have a growing economy it is necessary to have industries whose products have a high income elasticity of demand. A good with a high income elasticity of demand means that as incomes rise, so will the demand for the good rise and growth will be further stimulated (Thirlwall, 1982). Hence, such a good can provide an in-built dynamic of growth as an element in the system. There is a considerable amount of debate surrounding the issue of high income elasticity. There are the advocates of the Fisher-Clark thesis[94] that consider income elasticity to be a particular characteristic of services and those who consider it from the perspective of the price elasticity of

[94] This was first proposed in the 1930s and rests upon the linear model of economic change, the transformation of the economy from an industrial to a service based post-industrial economy. Hence the weight of employment moved from the primary sector to the secondary sector and then to the tertiary or service sector.

demand perspective (Gershuny & Miles, 1983). The price elasticity of demand perspective assumes that demand for goods is sensitive to price, though the sensitivity varies by product. Thus if services become more expensive in relation to manufactured goods, the price effect might outweigh the income effect. Some argue that we are moving towards a 'self service economy' as the growth in service employment is interpreted as an increase in demand for goods as households substitute goods for services. On the contrary Bell (1980) interprets the growth of service employment as an indication of the growth in demand for services.

4.2.3 Productivity

It is argued that productivity growth has increased faster in manufacturing than in services and for this reason manufacturing has a more dynamic impact on output growth than do services. There has been a contradictory approach in regional policy and investment regarding the role of employment in determining growth within a sector. One of the major criticisms of the regional policy of the late 1960's and early 70's (with reference to Appendix 2) was that much of regional grant aid was targeted to large firms whose subsequent investment programme made plants more competitive but at the expense of job losses[95] and familiarly termed jobless growth. For the period 1968-1973 labour subsidies dominated regional industrial assistance spending in Britain with the primary aim of creating job opportunities in the assisted areas (Wren, 1966). In part this contradiction of regional aid specifically targeted at the manufacturing industry led to policy attention to focus on services.

The debate surrounding productivity is intertwined within two arguments considering the key role of manufacturing industry in the economy. The first being innovation and technical change and the

[95] For example the chemical industry of Teesside which received many millions of pounds of regional policy aid suffered from loss of jobs.

second being increasing returns to scale. It is argued that innovations and technical changes are more highly clustered in manufacturing than services. Harris (1987) in an article published by the Regional Studies Association cited research conducted by the Science and Technology Policy Research Unit (SPRU) which noted that of 'fundamental' innovations between 1945 and 1984 (classified by sectors) a majority of innovations took place in manufacturing. Moreover, whilst services were net importers of innovations made elsewhere, manufacturing sectors as a whole were exporters. Such arguments can be further examined by taking the manufacturing and service sectors of the economy as a whole. That is to say that some sectors of manufacturing are more innovative than others. The same may apply to the service sector. One of the main reasons for presuming that the manufacturing sector is more innovative in comparison to other sectors is based on the proposition that capital investments largely in machinery, is at a much higher proportion than the services sector's capital investment is in buildings. This may be true but it does not take into account that in some service sectors capital investments may change if they are on the verge of a micro-electronics and software revolution. Finally, many advocates argue that this debate could be further advanced by the fact that new technological developments today are blowing apart the classical distinction between manufacturing and services. Thrift (1987) comments: *'the old division of the economy into manufacturing and the service sector seems increasingly suspect. If the application of products is becoming more important than their production, then perhaps a division into information and non-information-producing categories is more useful'*. Also services require manufactured goods for delivery (ICT).

The other argument about the significance of productivity increases in manufacturing relates to increasing returns to scale: which is, that productivity increases as output grows. Arrow (1962) and Young (1928) introduced the notion of increasing returns and positive externalities which led Myrdal (1957) Kaldor (1972) and others to identify the twin processes of virtuous cycles of growth and vicious cycles of decline. Kaldor (1966) argued that in manufacturing these returns are high, occurring both through economies of scale in production and also through agglomeration economies. This signifies that a growing manufacturing process is able to instigate a process of cumulative causation. For Kaldor, manufacturing acts as an engine of growth as it exhibits increasing returns while services are characterised by diminishing returns. As noted earlier the notion that manufacturing is only able to exhibit increasing returns may be too simplistic as increasing returns are likely to exist in services (despite problems of measurement). This does not, however, diminish the importance of the cumulative causation analysis for understanding the diverging economic performance and prospects of different countries. Firstly, divergences in countries' growth paths can develop as a result of differences - due to the size of the market - in the ability of competing countries to exploit increasing returns in their tradable output sectors; and the tradeble goods sector remains dominated by manufacturing. Secondly, the cumulative causation processes will not lead to differences in cost competitiveness but also to other non-price factors, such as product quality, customer service and technological development.

The following section of this chapter will begin by presenting the case that manufacturing decline is an inevitable process of historical evolution, paying particular attention to de-industrialisation. De-industrialisation is often used to describe the relative decline of manufacturing industry rather than the industry as a whole. The definition of de-industrialisation will be described and then consideration will be given to the theory of de-industrialisation as well as its relationship to economic growth.

4.3 De-industrialisation

There is a considerable amount of debate surrounding the definition of de-industrialisation. For example Rhodes (1986) defines de-industrialisation as the failure of a country or region to secure a rate of growth of output and net exports of all kinds sufficient to achieve full employment. However Singh (1977) defines it in terms of the economy's ability to sell enough of its products abroad to pay for the nation's import requirements, and to achieve this whilst maintaining socially acceptable levels of output, employment and the exchange rate. However this may not be the case today. For some, de-industrialisation refers to the activity in the economy as a whole. For others de-industrialisation is solely concerned with the decline of manufacturing. The most common definition of de-industrialisation is the absolute decline[96] of manufacturing employment. Others, however, consider de-industrialisation from the perspective of the relative decline[97] as an indicator whereby output is considered as opposed to employment. Furthermore, there has been a considerable amount of debate over the nature and causes of de-industrialisation (Singh, 1977, 1987; Rowthorn & Wells, 1987).

According to Petit (1986) the relative decline of manufacturing and manufacturing employment, together with the corresponding relative growth of services, is prevalent in both slow and fast growing countries. The relative decline of manufacturing has led some to see the process as being some sort of inevitable historical evolution as advanced by Fisher (1935) Rostow (1960) Kuznets (1966) and Chenery (1960). The argument

[96] The absolute decline of manufacturing in concerned with absolute levels of employment (usually) or (occasionally) output in the economy as a whole.
[97] The relative decline in manufacturing is concerned with the decline of manufacturing as part of the economy. Possible measures include the manufacturing's share of employment (usually) or (occasionally) output in the economy as a whole.

expressed is that there are definable stages of economic development[98] which have common features including the final stages being characterised by the modern tertiary sector with growing preferences for service products.

Furthermore, there is considerable literature which seeks to explore the significance of the changing geography of production. There exist four strands of thought which are particularly noteworthy when exploring the significance of changes for the geography of production. First, the rise of new industries implies the development of new industrial areas and the decline of old ones. The changing circumstances of production are said to be readily mapped onto the rise and fall of regional fortunes (Hall & Markusen 1985; Markusen *et al.*, 1986; Scott, 1988, 1988a). The second strand of thought is based on the product life cycle concept, where the belief is that production is being rapidly reorganised internationally, especially through the operations of multinational enterprises, so that routine operations are located where the labour cost are low. At the intra-national level Massey (1984) has drawn attention to the shifts in the location of production reflecting the skill requirements of processes and labour and other characteristics of regions. Finally it has been argued that the flexible production system in which just in time sourcing is important implies the advantages of proximity. Hence the assertion of the economies to be gained from agglomeration (Poire and Sabel, 1984; Scott, 1988, 1988a) to which further must be added the advantages of

[98] The definable stages of economic growth are: 1) The first stage of economic history of most regions is one of a self-sufficient subsistence economy in which there is little investment or trade. The basic agricultural stratum of population is simply located according to the distribution of natural resources; 2) Further with improvements in transport the region develops some trade and local specialisation and intra regional trade; 3) With the increase in intraregional trade, a region tends to move through a succession of agricultural crops from extensive grazing to cereal production; 4) With increased population and diminishing returns in agriculture and other extensive industries a region is forced to industrialise; and 5) The final stage of regional growth is reached when a region specialises in tertiary industries producing for export. Such a region exports capital, skilled personnel and special services to less advanced regions.

proximity to markets gives in responding to market place trends (Schoenberger, 1986; 1987). Gertler (1988) disagrees with this analysis and has raised pertinent questions concerning the nature and scale of changes which have affected the manufacturing industry, suggesting that the shift form 'Fordist' to 'flexible' production has been exaggerated. In the writers view, rigid mass-production systems have in fact coexisted with more flexible production.

However, when returning to the notion of the advantages of proximity to markets, economists for years have emphasised the benefits of the localised concentrations of industrial specialisation which can be traced back over hundred years to Alfred Marshall (1890). He argued that Britain's economic growth and leadership during the 19th century was founded on the development of several examples of localised industries. A century later, economists have rediscovered Marshall's work on industrial localisation, reinventing his work with a new found focus encompassing new ideas and concepts. Also, economic geographers have been researching similar issues for the past two decades, although using somewhat different labels. Economic geographers have various labels for localised industries such as 'industrial districts', 'new industrial spaces', regional industrial complexes', local high-tech milieux and so on, according to the specific characteristics of the local agglomeration in question (see, for example, Scott, 1989, 1998a; Amin and Thrift, 1992; Harrison *et al.*, 1996; Markusen, 1996). Michael Porter's (1998) work on 'clusters' has been the most influential of all. His work on 'cluster theory' has become a standard concept in the field, and policy-makers the world over have seized upon Porter's cluster model as a tool for promoting national, regional and local competitiveness, innovation and growth. Despite the popularity of the cluster concept, there is much about it that is problematic. See Martin & Sunley (2002) for a critique of the cluster concept.

The importance of the relative decline in manufacturing is based on the proposition that there is a faster relative growth of labour productivity in manufacturing than in services. This will result in the costs of manufacturing falling relative to services. Assuming that the demand for manufacturing and services is relatively price inelastic, the share of manufacturing employment in total employment will decrease. Many studies including those by Fuchs (1968), Baumol (1967), Saxonhouse (1985) and Summers (1985) presented evidence that productivity differences are the main source of decline in manufacturing employment. However, others such as Marquand (1979) dispute that services have low productivity.

Most of the productivity analysis of the service sector is limited due to problems in obtaining reliable empirical data. In particular there are substantial difficulties in measuring productivity in services as in most cases no physical output is produced. According to Gershuny *et al.*, (1983) in the UK service productivity may actually be lower than the official figures suggest which further adds support to the idea that differential productivity growth between the manufacturing and service sectors plays an important role.

A second explanation for the relative decline of manufacturing and the relative growth of services stems from the changing structure of demand as incomes increase. This explanation is relevant to the growth of personal or consumer services as opposed to intermediate or producer services, although the distinction is often arbitrary. It has been argued that, as income elasticity of demand is greater than one, the growth in demand for services will exceed the growth of income. Gershuny (1978) for example, highlighted that in Britain wealthier households spent a greater proportion of the income on services. However, such a correlation seems to be unstable over time and suffers from definitional problems, as much of this service expenditure is on associated goods. Fuchs (1968) argued that income elasticity of demand for services was only slightly higher than that for other products and was not a major explanation of the growth of the service sector. In the same way Baumol *et al.*, (1989) rejected the demand explanation for the US during the past few decades as manufacturing output has risen as fast as the output of services. Rowthorn and Wells (1987) argued that (measured at constant prices) demand for manufacturing and services tend to increase at the same rate as economies reach industrial maturity.

A third explanation for the relative decline of manufacturing is the changing source of service provision, with activities which were previously undertaken within manufacturing firms becoming increasingly contracted out to the service sector. Fuchs (1968) found that changes in intermediate service production in the US accounted for 10% of the total expansion of service sector employment and Rajan (1987) reports evidence of increased contracting out of intermediate services in the UK during 1973-1983.

4.3.1 Manufacturing Output and Employment

In summary, Table 21 below compares the UK's manufacturing performance with its main competitors. The UK is the only one of the five countries with a lower average level of manufacturing output (0.9%) over the years 1979-90 with Japan showing the highest (4.7%). However for the period 1990-95 Japan experienced the slowest output growth (0.4%) with the USA experiencing the fastest growth in output (3.6%). For the period 1995-2000 the UK experienced the second lowest output growth (1.3%) with Italy experiencing the lowest output growth (1.2%). In addition for the period 1979-90 and 1990-95 the UK experienced the greatest fall in manufacturing employment in comparison to the other four countries. The UK experienced the second greatest fall in employment for the period 1995-2000 (-1.4%) with Japan experiencing the greatest decline in employment (-1.9%). When examining the three periods the UK was at the bottom and in some instances second bottom of the league tables of the four countries. This poor UK manufacturing output resulted in declining manufacturing employment.

Table 21: Manufacturing output and employment: International comparisons Average annual rates of change %

	Average Annual rate of change	1979-1990	1990-1995	1995 -2000
US	Output	2.4	3.6	5.4
	Employment	-0.8	-0.5	-0.1
Japan	Output	4.7	0.4	2
	Employment	1	-1.6	-1.9
France	Output	2	1.1	3.5
	Employment	-1.6	-2.5	-0.3
Italy	Output	2	1.5	1.2
	Employment	-0.9	-1.6	0.1
UK	Output	0.9	0.5	1.3
	Employment	-2.9	-2.6	-1.4

Source: US Bureau of Labor statistics (2005)

Rowthorn and Wells (1987) distinguish between "positive" and "negative" de-industrialisation. The former occurs when labour is shed as a result of manufacturing productivity rising faster than output: the displaced workers find new jobs in the service sector. Negative de-industrialisation (i.e. the UK experience) is characterised by rising unemployment and stagnant real incomes. A third kind of de-industrialisation occurs due to changes in the structure of foreign trade. This typology implies that the causes of "positive" and "negative" de-industrialisation are distinctively different - one is the product of "natural progression" and the other of "failure". Thirlwall (1994) distinguishes between negative[99] and

[99] Negative de-industrialisation is characterised by rising unemployment. Negative de-industrialisation as posited by Rowthorn and Wells (1987) is the result of a pathological phenomenon, namely of a structural disequilibrium in the economy which prevents a nation from reaching its growth potential or a full employment of its resources. It manifests itself in poor performance in the manufacturing sector and is accompanied by a slow-down in manufacturing and productivity.

positive[100] de-industrialisation and argues that the UK is suffering from negative de-industrialisation He argues that in comparison although manufacturing employment is falling in other major economies it is the result of a high rate of output growth being outstripped by an even higher rate of growth of productivity. Therefore, positive de-industrialisation alters the sectoral pattern of employment, but is consistent with a strong and growing manufacturing sector in output terms. In contrast, Thirlwall (1994) notes in Britain that falling manufacturing employment is the result of low growth output that is being exceeded by a mediocre rate of productivity growth. British de-industrialisation is essentially negative, the decline of manufacturing employment reflects the weakness of the manufacturing sector, rather than buoyant productivity growth, and is associated with a shrinking industrial base and stagnant output.

The UK experience of negative de-industrialisation is further supported by the data in Table 22, which reports output employment and output per person for the manufacturing sector. The picture for manufacturing output is one of a sharp fall in the early 80's which is supported by deep recession early in that decade leading straight into the Lawson boom in 1989, taking manufacturing output to a new peak in 1989 before falling again in the early 1990's. UK employment in manufacturing has shown a continual decline. Productivity (output per person) has grown every year apart from 1975 and 1980 even when output fell.

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[100] Positive de-industrialisation occurs when labour is shed as a result of manufacturing productivity rising faster than output; the displaced workers find new jobs in the service sector. A third form of de-industrialisation occurs due to changes in the structure of foreign trade.

Table 22: UK Manufacturing industry, 1970-2000: output, employment and output per person employed (indexes: 1992=100)

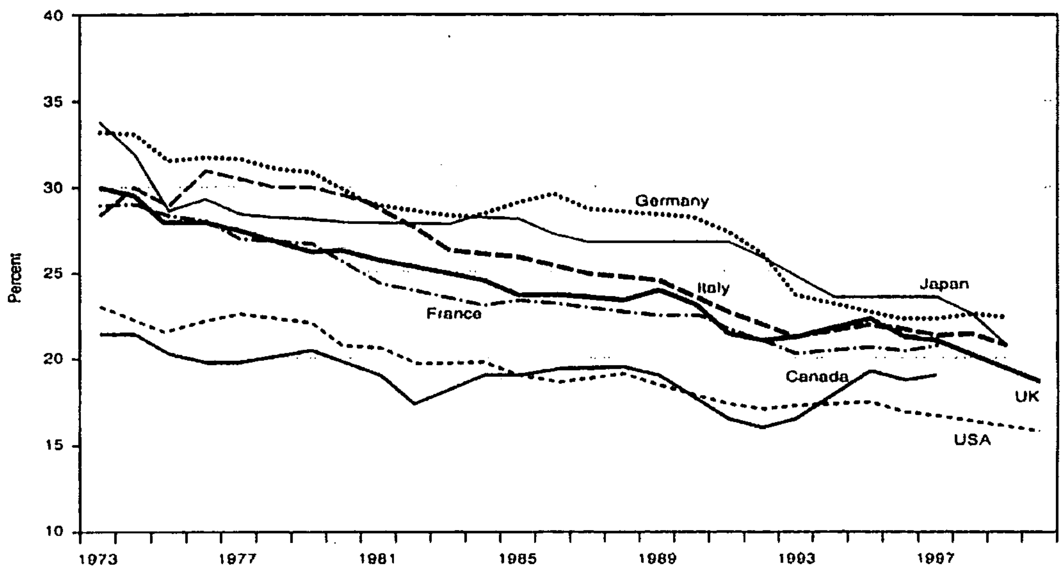
Year	Output	Employment*	Output per person employed in manufacturing*
1970	90.2	181.2	49.8
1971	89.3	175.1	51
1972	91.3	170.9	53.4
1973	99.7	171.9	58
1974	98.4	172.6	57
1975	91.6	164.7	55.6
1976	93.3	159.4	58.5
1977	95.1	160	59.5
1978	95.7	159.3	60.1
1979	95.5	158.7	60.2
1980	87.2	150.9	57.8
1981	81.9	137.4	59.6
1982	81.7	129.4	63.2
1983	83.4	122.8	68
1984	86.6	120.8	71.7
1985	89.1	120	74.3
1986	90.2	117.5	76.8
1987	94.6	116.4	81.2
1988	101.5	117.7	86.2
1989	105.4	118.8	89.3
1990	105.3	115	91.6
1991	100.1	106.3	94.2
1992	100	100	100
1993	101.5	97.1	104.5
1994	106.2	98.2	108.2
1995	107.8	100.9	106.9
1996	108.6	101.6	106.9
1997	110.7	101.8	108.7
1998	111.3	101.3	110
1999	112.1	97.7	114.8
2000	115	94.1	122.2

*all employed persons (employees and self employed)

Source: US Department of Labour, Bureau of Labor Statistics (2005)

As with other major industrialised economies, the overall proportion of output and employment accounted for by manufacturing has fallen over the past 30 years. Figure 5 shows the proportion of national output provided by manufacturing for the period 1973-2000. It is apparent that manufacturing as a percentage of GDP has fallen steadily over the past thirty years in the major industrialised economies. In 1960 UK manufacturing accounted for 35% of GDP; by 1999, this had fallen to 19% compared with corresponding falls of 27 to 16 per cent for the US and 39 to 22 per cent for Germany. Output in France, Germany, Italy, Japan and the USA all showed parallel decline. Manufacturing employment as a percentage of overall employment has fallen even more sharply in the major industrial countries over the past 30 years.

Figure 5: Manufacturing as a percentage of GDP 1973-2000



Source: DTI memorandum (2002)

In a memorandum submitted by DTI to the Trade and Industry committee (2002) various key factors were identified that affect all industrial economies and explain the relative decline in manufacturing's share of GDP:

- **Rising Incomes** - as incomes grow, consumers tend to spend a lower proportion of income on manufactured goods. Consumers are able to devote much of their increased income to luxuries, particularly services.
- **Technology** - the stock of scientific and technological knowledge is expanding at a growing rate. Modern economies are characterised by

unprecedented speed of technological change, providing the opportunity for firms to develop innovative new products to meet the needs of increasingly sophisticated consumers. Productivity advances in manufacturing is more rapid than in the service economy. As well as helping to account for the declining share of employment in manufacturing, this contributes to a decline in the relative price of manufactured goods, which in turn partly explains the decline in the share of manufacturing in the value of output.

- **Globalisation and Trade** - open markets and rising flows of trade and capital further intensify international competition. Some decline in the importance of production of manufactured products in advanced economies is to be expected as a result of this increased competition. This means that businesses in all advanced countries need to be ever more productive and innovative in the face of lower-cost competition in standard products. However, globalisation also means that successful firms have much larger markets for their innovative products, permitting profitable specialisation. Globalisation has also led to changing patterns of production.

The fall in the share of manufacturing output in GDP can in part be explained by a tendency to outsource service inputs previously provided within manufacturing concerns. This has taken place as companies have restructured to concentrate more on their core businesses to improve performance. The result is that some activities which had previously been included within the manufacturing sector are now undertaken in firms classified within the service sector. There is a growing trend, for example, for companies concerned with logistics to be required by their customers to provide final assembly operations. This manufacturing activity would be classified as a service when undertaken by logistics companies (see section 4.5 for an in-depth discussion).

4.4 Economic renaissance

Manufacturing industry is facing a period of great change which necessitates a significant amount of restructuring. As noted earlier in the introduction of this chapter this is primarily being driven by the increasing economic integration and interdependence of countries commonly referred to as globalisation. Economic globalisation in the 21st century has proceeded along two main lines: trade liberalisation (the increased circulation of goods) and financial liberalisation (the expanded circulation of capital). Globalisation has been enabled largely by improved communications - both telecoms and travel. It impacts all along the supply chain, with global companies wanting to deal with global suppliers and so on. The world has become a smaller place and it is now easier to manage manufacturing operations in low-cost countries. A prominent feature of the ongoing globalisation has been the offshore outsourcing of manufacturing to developing economies where labour costs are much lower.

Outsourcing (the contracting out of business functions previously performed in-house) has heightened concern among workers about job security. More particularly, the increasing trend of *offshoring* (the contracting out to foreign as opposed to domestic affiliates) prompted many to suggest that this phenomenon is leading to a reallocation of jobs from developed to developing countries. In some industrialised economies 'Jobs lost abroad' has become a familiar headline in newspapers. According to Polaski (2004) two events have fundamentally changed the way labour markets function. The first being technological advances in the form of information and communication technology which has lead to an increase in the number of jobs that can be transferred to offshore locations. The implication is that the outsourcing phenomenon is no longer limited to the manufacturing sector but also includes the transfer of highly skilled jobs in the services sector.

Secondly, the opening up of labour markets in China and India has brought a vast number of low wage semi-skilled workers into the global production system.

The implication of these two events heightened the sense of competitive pressure on employees as labour markets to become increasingly more integrated on a global scale. This has increased anxiety among workers, particularly those who cannot easily relocate in order to find employment (such as older workers and single parents with children). At the same time the globalisation of production has helped to drive down wages in certain sectors of developed economies as they face increased competition from lower-wage economies.

Without a doubt many multinational firms have shifted production facilities to developing economies to take advantage of lower labour costs. But the extent to which the share of developed economy jobs have gone overseas may be overstated. According to Polaski (2004) statistics based on job losses due to outsourcing in some of the developed economies show:

- In the US (the largest outsourcer of the industrialised economies) estimated job losses due to outsourcing represent only a small fraction of jobs lost in a given period. For instance the first three months of 2004 less than 2 per cent of mass lay-offs in the US were due to outsourcing (this includes domestic outsourcing).
- In Europe the outsourcing phenomenon is not as widespread compared to the US yet. Germany is by far the largest outsourcer of employment in Europe, perhaps due to its proximity to Eastern Europe. Outsourcing in Germany resulted in a loss of roughly 8,000 jobs per year from 1990 to 2001, mainly to Eastern Europe. This figure represents only 0.2 per cent of Germany's labour force,

which comprises 40 million people. It is also a small fraction of total jobs lost on a yearly basis.

- Outsourcing is a two-way process, economies may lose jobs due to outsourcing but they also gain jobs as a result of insourcing. Parry (2004) in a study based on the US shows that the US economy insources far more businesses than it outsources. In 2003 it outsourced approximately 77 billion US dollars worth of "business professional and technical services" to foreigners and insourced 130 billion US dollars (Parry, 2004).

However, Sperling (2004) argues that statistics only portray a partial picture, which downplays the emphasis of current statistics and focuses instead on the increasing trend in the types of jobs being outsourced. By changing the focus a different depiction of the phenomenon emerges. For example half of the major companies in the US currently engage in some form of outsourcing and more expect to do so in the coming years. In addition the expansion of outsourcing across occupational groups, including highly skilled jobs in the service sectors suggests that all phases of the production process can be "globalised."

> *"Even if many of the outsourced jobs are low-skilled call centre positions, reports of software programmers and...analysis being outsourced creates in millions of workers the fear that a college education and a professional job are no longer enough"*(Sperling., 2004)

Over recent years there is growing concern that the quality of jobs being created in the developed economies has been declining mainly due to outsourcing. The concern is that growth in employment is driven by jobs in less decent working conditions (in terms of pay and job security) than those that have been lost. The evidence is mixed regarding this. An OECD (2003b) study shows that over the past ten years part-time employment has accounted for half of the total employment in the OECD economies. In particular there has been strong temporary employment.

The trend in part-time and temporary employment has been particularly strong among women and youth and accounts for their growing numbers amongst the workforce.

Exactly how outsourcing will ultimately impact on growth and employment in developed and developing economies remains to be seen. The challenge for economies will be how to integrate themselves into the global production process in order to create decent employment opportunities for those seeking work. For developing economies it will require increasing the absorptive capacity of their labour force and institutions and the ability to utilise technology transferred from the developed economies. For developed economies it requires a stronger focus on innovation and expansion into new markets.

The benefits from outsourcing can be derived through a number of channels - global linkages in the supply chain which have created opportunities for increased income in the developing economies. In turn this has increased demand for more skill intensive products in developed economies. The challenge for both the developed and developing economies is to adapt to the rapid changes in technology, which are speeding productivity gains and the rate of job creation and destruction, and to provide social safety nets for workers who are displaced during this process.

Globalisation has been the cause of the loss of competitive advantage in certain labour intensive industries in the industrialised economies, leading to a loss of jobs (Kucera & Milbery, 2003). However, there has not been a net transfer of jobs to developing economies and studies have shown that the decline in industrial employment across economies is due more to the gains in the efficiency of production than to the loss of jobs to developing economies, a worldwide trend (Alliance Bernstein, 2003).

Innovations in the production process have increased efficiencies in traditional industrial sectors, not only in developed economies but also in developing economies, as increasingly more output can be produced with fewer workers. According to one study (Alliance Bernstein, 2003) between 1995 and 2000 roughly 22 million jobs were lost globally, a decline of 11%, yet over the same period, global industrial production increased by more than 30%.

In addition International labour standards are necessary in order to ensure that low cost labour is not synonymous with the exploitation of labour and that decent work conditions prevail. Some developing economies that have entered into the global supply chain have done so through the "low road" option to development. These economies compete based on low cost, low skilled labour - a growth strategy that is not sustainable, because it often does not lead to productive work. For example, although the quantity of work has been increasing in the manufacturing sector in Mexico with the rise of the maquiladoras (maquila factories) the quality of employment has not improved leading to a "decent work deficit".

In chapter three section 3.3 the US was identified as the only country which experiences and continues to do so high productivity and employment growth in the total economy. In 1995, the US economy experienced a resurgence in labour productivity growth[101] defined as real output per hour worked. After growing only 1.3% per year from 1973-1995, productivity growth jumped to 2.5% from 1995-1999 (Stiroh, 2001). This striking revival has not gone unnoticed with academics, policymakers and the resulting hotly debating and competing explanations. Some commentators emphasise rapid capital accumulation

[101] Labour productivity is defined as real output per hour worked.

and the recent investment boom whilst others point to deeper factors like the fundamental technological change in high-tech industries, and others argue that cyclical forces provide the primary explanation. This debate about the forces driving the US economy mirrors a larger debate between the neo-classical and new growth theories regarding the sources of economic growth[102]. In an article published by the New York Federal Reserve Bank (2001) Kevin Stiroh attempts to explain the rise in US productivity growth using models developed by neo-classical and new growth economists both of which contribute to our understanding of the growth process. The neo-classical[103] type of analysis enables one to understand *what* happened to the US economy whilst the new growth theorists[104] enable us to understand *why* technical progress accelerated in high tech industries.

Stiroh's results based on the neo-classical model explained the accelerated aggregate productivity growth in the US economy was due to a combination of accelerating technical progress in high-tech industries and corresponding investment and capital deepening. Under the endogenous growth framework which aims to provide an explanation as to why it happened Stiroh (2001) proposes on the need to focus the incentives and actions of the firms that actually invest, innovate and create the new capital knowledge that is driving the US economy. Evidently as a new growth pattern[105] has emerged in the US, EU

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[102] In the neo-classical view, exogenous technical progress drives long-run productivity growth since broadly defined capital suffers from diminishing returns. In contrast the new growth models yield long-run growth endogenously, either by avoiding diminishing returns to capital or by explaining technical progress internally.
[103] Measures the rate of technological change.
[104] Provides an internal explanation for the sources of technological change.
[105] In an examination of the annual % change of the trend labour productivity growth rate for manufacturing and private services sectors of the EU and US for the period 1981-1999 Denis, *et al.*, (2004) found that the average trend productivity growth in the manufacturing sector has always been higher than that of services in both EU and the US. However the recent surge in productivity growth in the US service industries is suggestive that the latter industries could challenge manufacturing in the not too distant future (for a further discussion see, Bernard and Jones, 1996). If this was to occur it

employment and productivity growth patterns have sharply diverged from the US over recent years more especially during the period 1996-2002 (Denis *et al.,* 2004). In an industry level analysis based on OECD's STructural ANalysis (STAN) database, Denis, *et al.,* (2004) attempt to access whether Information Communication Technology (ICT henceforth) is the main source of the diverging productivity differentials between the EU and the US. The results of the study reveal that over the 1996-2000 period services have been the biggest contributor to the total labour productivity growth in the US. In addition the US has pulled ahead of the EU over recent years in terms of productivity growth rates. This is essentially due to the superior performance of the US in a wide range of ICT-producing[106] and ICT-using industries. Services are the main source of the US productivity advantage over the EU; the US appears to have benefited from substantial investment in the intensive ICT-using service industries such as wholesale and retail trade and financial services (see Appendix 4 for top 10 industries in the EU & US). In addition five industries in terms of contributions to economy wide productivity growth dominate the overall pattern with all these industries in the ICT-producing and the ICT-using areas. Of the five industries the US outperforms the EU in 4, namely in one ICT-producing manufacturing industry (i.e. Semiconductors and other electronic equipment) and in 3

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would have enormous implications for the overall growth performance of the US economy since the private services sector is three times larger than that of manufacturing in terms of both output and employment shares. In addition at least until the mid 1990s the manufacturing sector accounted for between 60-75% of the total US productivity growth despite representing only 15-20% of total employment. The EU experienced a marked downward trend in productivity growth in both manufacturing and service industries over both decades 1980s and 1990s. The US in contrast is characterised, in manufacturing by a declining trend only up until the end of the 1980s followed by a strong recovery in the 1990s. For services the US has been on a steady upwards trend since the early 1980s and has now opened up a marked advantage over the EU in such industries, with the US private services productivity growing from a pace of less than 1 percentage point on an annual average basis in the early 1980s to well over 2 percent in the second half of the 1990s.

[106] The complete breakdown of the ICT intensity of 56 industries into ICT-producing, intensive ICT-using and less ICT-using industry are based on the University of Groningen's Growth Development Centre's ICT intensity breakdown as seen in Appendix 3. See OECD (2000) *Measuring the ICT Sector.*

ICT-using service industries (i.e. wholesale trade; retail trade; and financial services). The EU is more dominant in one ICT-producing service industry, namely telecommunications. Whilst productivity in ICT-producing manufacturing industries has been growing at a significantly faster pace than the associated ICT-using service industries it is the latter group of service industries which account for by far the greatest portion of the US upsurge in productivity. This contradiction is explained by the higher share of ICT-using service industries in overall value added.

The article stresses that the EU as a whole has a productivity problem relative to the US in terms of aggregate productivity trends which appear to emanate from two distinct factors. Firstly 50% of the EU's decline can be attributed to a reduction in the contribution from capital deepening. Secondly the remaining 50% decline in the labour productivity growth stems from a deterioration in terms of the total factor productivity. This is considered to be the greatest source of concern to policy makers as changes in total factor productivity are generally attributed to more efficient resource utilisation emanating from market efficiently[107]. In terms of policy conclusions the article stresses that international labour productivity differentials to a large extent reflect differences in the basic determinants affecting physical capital formation (especially the regulatory environment and the structure of the financial markets) and the creation of knowledge (where R&D expenditures are closely linked with educational attainment levels, the openness of economies and market size considerations).

In an article by Jorgenson *et al.*, (2004) titled *'Will the US productivity resurgence continue?'* which aims to project future US productivity growth,

[107] This includes technological progress resulting from investments in human capital, R& D and information technology; or natural catching up process of less developed EU countries through increased business investment in general.

it is pointed out that productivity gains come from technological progress in the industries that produce IT equipment and software as well as an ongoing shift by firms toward the purchase of relatively cheap and highly productive IT equipment. Future US growth of productivity depends critically on hard to predict factors such as the evolution of the semiconductor technology and business investment patterns.

4.5 The competitiveness and productivity of UK manufacturing industry

In 2002 DTI published its Manufacturing Strategy which highlighted that the Government views manufacturing success as being critical to the prosperity of Britain, now and in the future. The Manufacturing Strategy indicates that the manufacturing sector accounts for a fifth of the UK economy and that manufacturing companies employ about four million people and many more indirectly. Manufacturing and service sectors are critically interdependent. That is to say, simply through the direct supply chain links between industrial sectors a further 2.4 million service sector jobs depend on manufacturing and the total interdependencies no doubt reaches far beyond this figure (DTI, 2002a). In addition internationally, the manufacturing sector accounts for sixty per cent of UK exports, and also contributes substantially to the balance of payments (DTI, 2002a).

Manufacturing plays an integral role in any growing and prosperous economy. UK manufacturing is in the midst of significant structural change, which is inevitably due to the increasing world-wide integration of markets for goods, services and capital of globalisation. The 1997 Labour Government identified various factors which are affecting the competitiveness and productivity of the UK manufacturing industry and introduced various policies and initiatives such as the Manufacturing Strategy to encourage and support manufacturing industry.

4.6 Manufacturing productivity

The main objective of the Government's industrial policy is to increase the country's prosperity and more specifically reduce its productivity gap with other leading industrialised countries. Table 23 shows that in 1999 US manufacturing productivity measured as output per hour worked is 55% higher, France 32% and Germany 29% higher than the UK (National Institute for Economic and Social Research (NIESR), February, 2002). Part of this gap is explained by lower investment intensities in UK manufacturing and partly by all the other factors (total factor productivity) that influence productivity levels, such as work organisation and practices. The UK manufacturing sector has a significant gap on both sides. Differences in investment levels are more important in explaining the gap against Germany and France than against the United States (see section 3.6.6).

Table 23: The Manufacturing Productivity Gap in 1999

Output per hour worked in 1999	Labour productivity	Total factor productivity
US	155	143
France	132	110
Germany	129	121
UK	100	100

Source: NIESR, February 2002

The UK is not alone in seeing a substantial reduction in manufacturing employment, as can be seen from Table 24. An explanation for why many of the well developed manufacturing economies show a decline in manufacturing employment over time is due to the shift from low cost, labour intensive manufacture to high value added, capital intensive manufacture requiring highly skilled labour.

Table 24: Manufacturing employment as a percent of total employment

	UK	France	Germany	Japan	US
1980	28.3	29.5	33.9	24.7	22.1
1999	17.9	18.6	-	20.8	15.0

Source: OECD, 2001a

In an analysis of the manufacturing productivity gap by the National Institute for Economic and Social Research (NIESR) cited in the House of Commons Trade and Industry Committee Report (2002) various key determinants of manufacturing productivity are identified; capital intensity, skills levels within the workforce and the effectiveness with which capital labour and skills are combined, as measured by total factor productivity. In addition to the determinants cited by the NIESR the Trade and Industry Committee Report identified additional factors affecting productivity such as management issues, innovation and investment in research and development, and the regulatory burden on business particularly SMEs. These determinants of manufacturing productivity are explored below.

4.6.1 Capital Intensity

Low physical capital stock is considered to be a major factor contributing to the productivity gap. The Confederation of Business Industry (CBI) and others have argued that the capital stock of firms and the stock of public infrastructure in the UK have been known to be well below those of its main competitors. According to a memorandum presented to the House of Commons Trade and Industry Committee in 2002 the TUC suggested that the UK's weak performance in public sector investment was far worse than any other economy of the EU or the US over the past 20 years. In addition bad transport infrastructure links impose additional costs to business and reduce efficiency for firms in many ways, such as higher transport costs, greater uncertainty in delivery time and reduced labour mobility. NIESR calculated that in 1999, compared with the UK, capital investment per hour worked was 80% higher in France, 34% higher in Germany and 33% higher in the USA.

One explanation for the low capital investment in the UK has been that historically the volatility of the macro-economy played a major part in discouraging long term investment in manufacturing. Although more recently the macro-economic policies of successive governments have been associated with a sustained period of relatively low inflation and a more stable economy. However liberalisation of markets combined with the world recession has forced companies to reduce prices in order to remain competitive leading to smaller profit margins thus restricting the ability of firms to make funds available for investment.

4.6.2 Skill shortage

O'Mahony *et al.,* (2002) shows that there is a significant gap with regards to the skills base within the workforce between UK industry and its major EU competitors. A survey of economic evidence by the OECD (2001a) suggests that investing in training by employers tends to increase profits, productivity, and wages (OECD Economic Outlook, December 2001a, p.163). These studies have demonstrated a positive link between investment in employee training and productivity.

Table 25: Britain's vocational skills deficit in 1999

% of Workforce	Higher Skills	Intermediate Skills	Low Skills
US	28%	19%	57%
Germany	15%	65%	20%
France	16%	51%	32%
UK	15%	28%	54%

Source: NIESR 2002

In an estimate of the skills composition of the workforce in 1999 shows that the UK matched Germany and France in terms of graduate level qualifications, but was far behind in intermediate skills. The US was even worse than the UK in terms of vocational skills but this deficit was offset by deploying a large number of graduates. NIESR estimate that for the market sectors of the economy skills accounted for about 25% of the productivity gap against Germany and 14% of the gap against France. However, skills did not play a significant role in explaining higher productivity in the US compared with the UK. These estimates are for the total economy but are likely to be equally true for the manufacturing sector.

4.6.3 Management issues

The quality of management in UK manufacturing has also been identified as a barrier to improving productivity. In the study published by McKinsey & Company (2002) titled *"Reviving UK Manufacturing"* they argue that the productivity gap has nothing to do with the labour force, as many UK foreign owned manufacturing companies are drawing from the same pool of talent, working within the same regulatory framework and constrained by the same scale effects as their UK-owned competitors. However, UK foreign owned manufacturing companies are more productive than UK owned companies. This view is further supported by the joint CBI/TUC Productivity Report (2001) which indicated that the proportion of graduate level employees in UK and the German manufacturing industries was roughly the same, but qualified engineers and scientists may lack managerial skills. The McKinsey Study (2002) identified three techniques[108] high performing manufacturers deployed which explains the reasons for the labour productivity gap. These techniques are:

1) **Lean management** which aims to minimise all waste in the manufacturing process. High manufacturing performers took a holistic review of the production system design and demonstrated continued commitment to being lean. The Engineers Employers' Federation (EEF) Productivity Survey (2001) has shown that firms which employ lean manufacturing techniques in their business get a significant return in terms of improved company performance. However, the adoption of these techniques is inconsistent. Only one third of UK firms have adopted lean manufacturing across their whole organisation while 40%

[108] These three techniques were also considered to be interconnected: high performers in one area were typically high performers in others as well.

have not undertaken any lean manufacturing at all (EEF, 2001). In comparison to its US counterpart, UK manufacturers have also been relatively slow to embrace new workplace initiatives such as output monitoring, performance appraisal and a range of other techniques to improve communication with employees. According to the EEF and others, the most common barrier to adoption of these improvements seems to be the opposition to change from management as well as employees.

2) **Performance management** which sets relevant goals at plant levels for each manager monitors their performance against these goals and provides incentives for attainment. The McKinsey survey (2002) highlighted that at even a basic level many average or poor performers lack key financial and operating results for the plant that they can understand, act upon and use as a continuous management metric for performance.

3) **Talent management** which attempts to attract and retain high calibre people. Many UK manufacturers struggle to recruit good people and fail to spot potentially strong performers and get the most out of them. The EEF Productivity Survey (2001) explained that low quality management may derive at least partially from a poor image of manufacturing as a career. The EEF Productivity survey also showed that nearly 25% of manufacturing companies have difficulties in recruitment and retention of suitable staff, and that these difficulties were undermining company performance.

4.6.4 Effect of exchange rate on competitiveness

60% of UK manufacturing exports are sold to European markets. The relative strength of sterling compared to the European currencies since 1997 has inevitably had a significant impact on the cost of competitiveness of UK manufacturers, who have found it difficult to compete effectively in EU markets. UK based manufacturers selling to domestic markets have also faced increased competition from relatively cheap imports and the comparative weakness of the Euro may have affected the competitive position of UK firms exporting to markets such as the US. Unsurprisingly the strength of the sterling has adversely affected the competitiveness of UK manufacturing in the short-term. This will inevitably impact upon productivity in the longer term, because UK firms have chosen to squeeze margins in order to remain competitive, rather than make efficiency savings.

4.6.5 Innovation and Research and Development (R&D)

The future success of UK manufacturing lies in the production of high value added goods rather than the production of bulk commodities for which production costs in the UK will always be higher than Asia. Innovation and the application of new technology are central to profitable growth in the value added end of manufacturing. A successful R&D programme is essential to new product development, more efficient production methods and therefore improved productivity. Furthermore there exists a link between R&D investment and the exploitation of new technology and high value added manufacturing.

Table 26: Investment in R&D in the 1990s

Share of GDP	1991	1995	1999 *Or latest*
Japan	2.8%	2.8%	3.0%
US	2.7%	2.5%	2.7%
Germany	2.5%	2.3%	2.4%
France	2.4%	2.3%	2.2%
UK	2.1%	2.0%	1.8%

Note: all figures gross expenditure on R&D; Japan and France are 1998. US figures excludes most capital investment

Source: Economic Trends, August 2001

In a Memorandum presented by the TUC to the House of Commons Trade and Industry Committee in 2002, *'Investment in Research and Development'* (R&D) noted that at the end of the 1990's total investment in R&D accounted for just over 1.8 % of GDP compared with 3% in Japan, 2.7% in the US, 2.4 percent in Germany and 2.2 % in France as presented in Table 26 above. It emerged that the UK's relative performance has fallen[109].

4.6.6 Regional Investment

The UK manufacturing sector has suffered from long period of relative under-investment. Work undertaken by Nigel Pain of the NIESR for the TUC and CBI investment productivity group in 2001 showed that investment as a share of industrial output has been falling over the past 25 years (Table 27).

Table 27: Investment Intensity in Manufacturing 1975-97

Share of output	1975-80	1981-90	1991-97
Germany	11.0%	12.1%	14.1%
France	13.5%	14.6%	13.5%
US	11.4%	10.8%	11.0%
UK	13.0%	12.1%	11.5%

Source: CBI-TUC Productivity investment Group

Table 27 shows the UK's position against France and Germany appears to have declined. The study suggests that in the market sectors of the economy lack of physical investment accounts for about 40% of the labour productivity gap with Germany and 60% of the gap with France.

Evidence submitted to the House of Commons Trade and Industry Committee (HC 597, 2001-02) by the Industrial Society suggested that the German Government's support to industry was more effective than the UK's because it was controlled at a regional level. The Society argued that this led all the actors-local, government, educational institutions, planning authorities, local trade bodies to co-operate to tackle problems and to develop common policies to build on area's strengths.

[109] It is important to note that during the German and Japanese recession the R&D expenditure would have been higher as a share of GDP due to the absolute scale effect of R&D.

4.6.7 Regulatory Burden on Business

The DTI's Small Business Service Omnibus Survey (2000) identified 'regulation' as one of the most important concerns among Small Medium Enterprises (SMEs). SMEs play a crucial role in the economy as can be seen from Table 28. Small firms account for 96.3% of total enterprises, followed by medium enterprises which account for 3% and large enterprises accounting for 0.8% of total enterprises. Large enterprises employ almost half of the workforce and contribute to 63.3% of turnover.

Table 28: UK SMEs shares

	Total	Small	Medium	Large
No. enterprises	8%	96.3%	3%	0.8%
Employment	18%	26%	21.8%	49.2%
Turnover	22%	18.1%	18.3%	63.6%

Source: National Statistics, Commerce, Energy and Industry, Size Analysis of UK Businesses Data for 2002

However, Table 29 and Table 30 shows in more detail turnover per employee for all industry groups and manufacturing. When considering Table 29 turnover per employee is the greatest (117.32) by medium sized enterprises closely followed by large enterprises (101.81). Large enterprises employ more people and account for the greatest amount of turnover in comparison to SME's.

Table 29: Number of businesses, employment, turnover by size of business and turnover per employee in all industries, 2001.

All Industries

Size (Number of employees)	*Enterprises*	*Employment ('000)*	*Turnover (£million)*	*Turnover per employee*
All industries	*3,746,340*	*22,622*	*2,112,013*	*93.36*
None	*2,596,395*	*2,888*	*152,383*	*52.76*
Small	*1,115,515*	*6,922*	*612,952*	*88.55*
Medium	*27,655*	*2,721*	*319,231*	***117.32***
Large	*6,775*	*10,092*	*1,027,448*	***101.81***

Source: National Statistics, Commerce, Energy and Industry, Size Analysis of UK Businesses Data for 2001

The employment breakdown shows 18% of the total workforce is employed in manufacturing industry divided almost equally between small medium enterprises and large enterprises. Manufacturing turnover accounts for 21.6% of total turnover, a further breakdown of manufacturing turnover shows that 63.6% of turnover is accounted for by large enterprises.

Table 30: Number of businesses, employment, turnover by size of business and turnover per employee in the Manufacturing industry section, 2001.

Manufacturing				
Size (Number of employees)	*Enterprises*	*Employment ('000)*	*Turnover (£million)*	*Turnover per employee*
All Enterprises	*292,750*	*4,103*	*457,239*	*111.46*
None	*167,330*	*193*	*7,709*	*39.94*
Small	*114,435*	*999*	*75,176*	*75.25*
Medium	*8,660*	*892*	*83,601*	*93.72*
Large	*2,325*	*2,019*	*290,754*	*144.01*

Source: National Statistics, Commerce, Energy and Industry, Size Analysis of UK Businesses Data for 2002

When considering Table 30 large firms show the highest turnover per employee. By comparing Table 29 and Table 30 it becomes apparent that the contribution of turnover per employee is greater for all manufacturing enterprises as opposed to all industries. Large manufacturing enterprises have the highest turnover per employee. Medium size enterprises in all industries show a much higher turnover per employee as opposed to medium manufacturing enterprises. Large manufacturing firms yielded the highest turnover per employee than any other sized business within manufacturing and in comparison to all industries.

The regulatory burden on business is mainly concerned with the compliance costs associated with new regulation and also the impact of new legislation from Europe and the way in which it is implemented in the UK. A great deal of controversy surrounds the debate on regulation, for example the OECD *Economic Outlook* Report (1999) suggests that the UK has the lowest product market regulation and that that the UK labour market is less heavily regulated than many EU countries. The British Chamber of Commerce (BCC) argue that poorly designed regulation can impose unnecessary costs on business which could impede innovation, competitiveness, investment and economic efficiency (HC 597, 2001-02 Ev 68). Regulation has a key role to play in that not only can it provide benefits to business but if poorly designed and implemented it can harm business.

4.7 Accounting for the Manufacturing Productivity Gap

Whether the productivity gap is expressed in output per worker or output per hour the gap between the UK and its international competitors is significant. NIESR attempted to explain the gap in labour productivity between the UK economy and the economies of the US, France and Germany, using as a starting point levels of capital services and skill-labour inputs. In addition data specifically for the manufacturing sector supports the findings on the importance of investment for the whole economy. Table 31 below demonstrates that the main factor accounting for the UK's productivity gap is a relatively smaller physical capital stock. The table also shows that the UK's low average skill level explains a significant part of the gap with France and Germany, which can be explained by the skills gap whereby a high proportion of workers lack intermediate skills (Nickell, 1996).

Table 31: Accounting for the Productivity Gap

% contribution of:	US-UK gap	France- UK gap	Germany-UK gap
Physical Capital	65	62	73
Skills	1	14	25
Total capital	66	76	98
Other Factors (TFP)	34	24	2
Total	100	100	100

Source: O'Mahony and de Boer, W, Britain's Relative Productivity Performance: Updates to 1999, NIESR (2002a)

The NIESR study further argues that the UK's whole economy productivity gap cannot be explained solely by lower physical and human capital. Table 32 shows the relative labour productivity gap in both the overall economy and in manufacturing after taking into account physical capital stocks and labour force skill (Total Factor Productivity (TFP). The TFP gap for the whole economy in Germany is insignificant, compared to the gap in the manufacturing sector which is much greater. The TFP gap with the US is much larger in manufacturing than the whole economy. The study reveals that the gap is made up of other factors which are difficult to measure but are likely to include competitive intensity and innovation including the application of new technology.

Table 32: Total Factor Productivity: international Comparisons 1999 (UK =100)

	US	France	Germany
Whole Economy	115	106	103
Manufacturing	143	110	120

Source: NIESR

In a memorandum submitted by the Department of Trade and Industry (2002) to the Trade and Industry Committee, the department recognised that the gap is made up of other factors which are difficult to measure but are taken into account for the differences in:

- Competitive intensity, Blundell *et al.,* (1995) and Nickell (1996) have shown that increased competitive pressures in an industry are associated with improved efficiency and productivity growth rates. Increased competitive pressure encourages firms to innovate and reduce costs as well as encourage changes to market structures, allowing successful firms to grow, and moving resources away from less efficient producers.
- Innovation including the application of new technology shows that the most rapidly growing manufacturing sectors tend to have high levels of R&D. Using data from the Community Innovation Survey (1996) which compares the share of manufacturing turnover from new or improved products. The data shows that

UK manufacturing is in the bottom half of the EU league in terms of revenue they earn from new or improved products.

- Management is a key input in to the production process and the quality of management can be crucial in determining competitiveness. According to Johnson *et al.*, (1999) and Bosworth (1999) the UK is performing behind most of its main competitors, and UK managers are inadequately qualified compared with international competitors. Furthermore manufacturing suffers from a poor image associated with low quality hence not enough young people are attracted to a career within the sector (See McKinsey & Company, 2002).

It becomes apparent that productivity growth is influenced by a range of factors, and most studies suggest that there is no simple way to boost it (Englander and Gurney, 1994a). Apart from some specific options, such as investment in education, R&D or infrastructure, policies to boost productivity often focus on the framework conditions for productivity growth underpinned by endogenous growth theory (see chapter two section 2.1.4).

The Labour Government recognises that manufacturing has suffered from decades of underinvestment in plant, labour force skills and R&D. In addition UK management has been slow to adopt good practices from abroad. The House of Commons Trade and Industry Committee (HC 597, 2001-02) indicated that

> *"Government can have only a limited role in solving these problems: managers, the workforce, capital markets, trade bodies and educational organisations all have at least as significant role. But Government can show the importance it accords to manufacturing by giving a vigorous lead. Because of the nature of the problems faced by industry, the DTI must have close cooperation of other Departments such as the DfES on training, the DTLR on planning and, not least, HM Treasury on incentives to promote investment implants and R&D, if the UK is really to become a world leader in this sector."* (HC 597, 2001-02)

Raising productivity is the key aim of the Department of Trade and Industry. This is reflected in policies to promote the spread of best practice, encourage innovation, raise skills and improve the transfer of ideas from the science base.

4.8 North East manufacturing strategy

Following the pioneering work of Paul Romer (1986) the theory of economic policy has been replacing the old idea of exogenous technological change as a main driver of economic growth to a much more sophisticated role for governments. Implying, the approach is not to pick winners or respond to market failures by trying to replace the market entirely. But instead by the proper role of governments utilised to effectively tackle short termism and market failures by making markets work more dynamically and encourage investment in the broadest sense: not just in machines but in technology and innovation, skills and infrastructure. To this effect the Government introduced a number of institutional reforms to take forward this new regional economic agenda and tackle market failures. In particular In England the Government established eight Regional Development Agencies (RDAs) to take lead in formulating regional economic strategies. They act as strategic leaders of economic development in their region and are responsible for carrying out detailed analysis of the region's particular strengths, weaknesses and needs. According to Robson *et al.*, (2000) the purpose of the RDA is specified in the 1998 Regional Development Agencies Act as:

- To further economic development and regeneration of its area;
- To promote business efficiency, investment and competitiveness in its area;
- To promote employment in its area;

- To enhance the development and the application of skills relevant to this employment; and
- To contribute to the achievement of sustainable development in the United Kingdom where it is relevant to its area to do so.

This section will briefly review the manufacturing strategy published by the North East Regional Development Agency titled *"Manufacturing in the regions: North East"* and then review the latest North East regional economic strategy consultation document published in 2005.

The North East manufacturing strategy recognises that manufacturing accounts for 20% of GDP and employs about 4 million people in the UK. This is considered to be a significant contribution to the UK national economy; therefore manufacturers are seen to play an important role. Within the regional context the report reveals that the manufacturing sector for the North East accounts for a greater proportion of employment and economic output than the UK as a whole. In addition independent forecasts made by Cambridge Econometrics show that by 2010 manufacturing will contribute 25.5% of the North East's GVA compared to 18.7% in the UK as a whole. This is despite the fact that manufacturing employment in the North East is forecast to fall from around 180,000 in 2000 to 146,000 in 2010, a fall of 19%.

The national Manufacturing Strategy published in May 2002 set out a strategic framework which identified seven 'pillars' where Government, RDAs, industry and all partners are expected to take affirmative action to help manufacturing address long term challenges. The 'pillars' include:

1. Macroeconomic stability
2. Investment
3. Science and Innovation
4. Best practice
5. Skills
6. Modern Infrastructure
7. The right market framework

The North East manufacturing strategy is structured within the context of the above mentioned national strategy framework. Each of the above mentioned 'pillars' are contextualised in relation to the North East (as discussed in Chapter three) supported by various regional case studies. Manufacturing is recognised to be a key facet to the continuing success of the region underpinned by:

- Investment which is considered to play a crucial role which will stimulate new enterprise, support job creation and encourage innovation.
- Initiatives to improve innovation and levels of R&D are considered to be a key element of the revival of manufacturing. By adopting best practice in production, workforce development and management the region's manufacturers will be able to improve their competitiveness.
- Developing the skills and education levels of the workforce are at the forefront at being able to meet the challenges facing manufacturing.

It is envisaged such developments will allow the North East's manufacturing industry to continue to be the foundation of the regional economy, a sector characterised by innovation and drive and continue to create wealth of jobs.

'Leading the way' the latest regional economic strategy[110] consultation document published by One NorthEast (2005) is divided into 5 distinct sections lettered A to D. Section D3 titled *"Sectoral and Global Networks"* recognises that the North East is underperforming in its level of competitiveness and productivity and highlights two reasons for the gap between the North East and the national average. Firstly the North East is over reliant on low growth and low value added sectors and activities; and secondly, productivity in the region's sectors is lower than the national average for those same sectors.

Increasing trade through exports of goods and services into national and international markets is identified as a powerful tool in raising the relative productivity levels of the North East.

> *"The North East has a high level of exporting with exports representing 58% of international trade activity, significantly higher than the UK average of 44%. The majority of Trade (almost 70%) is with few sectors all of which are manufacturing"* (Leading the Way p 47)

Inward investment is also recognised as another tool for increasing the productivity and participation within the North East economy. In the past the North East has attracted large scale enterprises into the region, employing a significant number of people. However it is emphasised that those investors have never been fully embedded into the regional supply chains, or who are competing in low value added activities, are footloose and vulnerable to future relocation to lower cost and lower wage economies.

[110] Since the formation of the RDAs two Regional Economic Strategies (RES) have been submitted. The original RES produced in 1999 (Unlocking our potential) was undertaken to inform the 2002 review process. The 2005 RES consultation draft builds on the previous strategies.

Manufacturing inward investment in the UK has declined steadily but the North East has secured the same number of overseas investment in 2002/3 as it did in 1998/99. Inward investment by the service sector in the UK has been steadily growing. London is the beneficiary of almost one third of all service sector inward investment. However in the North East service sector investment has been steadily increasing in its proportion.

The consultation document highlights the needs for the North East to be creative, developing global links and learning from international best practice in order to resolve problems within the region, particularly in relation to moving businesses up the value chain and closing the productivity gap. Hence the approach to the development of sectoral and global networks is summarised through the following strategic priorities:

1. **Sector Development**
    - Enhancing established significant sectors and helping create the right environment for 'new market' globally competitive sectors
    - Increasing manufacturing and service productivity
    - Managing a risk balanced portfolio of support to help address areas of market failure
2. **Global opportunities**
    - Encouraging exporting of goods and services within the UK and overseas
    - Attracting investment into the Region
    - Embedding companies within the regional economy

Under the *'Sector Development'* strategic priority and the sub heading *"Increasing manufacturing and service productivity"* the consultation document emphasises that manufacturing is crucial to the region as an employer and in terms of contribution to productivity. Hence in order to achieve an increase in productivity the region must apply best practice techniques to its current manufacturing base. It further indicates that the region needs to improve the performance of those sectors which are amongst the least resource efficient in the UK. In particular it is stated that large energy or material users which will benefit from adopting best practice resource efficiency.

> *"The North East has a greater dependence of manufacturing for jobs and GVA than the UK average. This trend is set to continue. However it is also forecast than employment in the North East's manufacturing sector employment in the North East will decline by 19% to 2010. To achieve a growth in GVA then labour productivity in the North East's manufacturing sector will have to increase significantly"* Leading the Way pg 51

In addition it stresses that there are strong links between manufacturing and service sector. Increasingly, manufacturers are closely working with designers, software companies and other service providers in bringing their products to the market. To this effect it is highlighted that in order to increase the productivity of the manufacturing sector the service sector must be developed which includes supporting the sector to become more knowledge intensive and higher value added.

In March 2001 the Chancellor of the Exchequer announced that the performance of the RDAs would be closely monitored through an agreed output and outcome framework. The purpose of the framework is to enable monitoring by the Government of the overall performance of the region in relation to economic development; therefore it is important that One NorthEast monitors its performance against targets. The framework is a mixture of indicators which relate to the overall performance of the region. There are three key elements of the targeting framework:

Tier 1 - Objectives

Tier 2 - Regional Outcome Targets

Tier 3 - Milestones or Output Targets

Tier 1 is based on the key national objectives for sustainable economic growth which draws on the Regional Development Agencies Act. Tier 1 targets are as follows:

- To promote economic development and regionally balanced growth
- To promote social cohesions and sustainable development through integrated local regeneration programmes
- To help those without a job to find work by promoting employment and enhancing the development of relevant skills
- To promote enterprise, innovation, increased productivity and competitiveness

These national objectives are addressed on a regional basis through the Tier 2 framework, which identifies 11[111] policy areas with specific regional outcomes measured over a two to three year time frame. These outcomes in many cases rely on a wide number of regional agencies and stakeholders for delivery, with the emphasis for the RDAs being strategic leadership.

The Tier 2 framework is a supplement to the Tier 3 regional output framework. This relates directly to the specific activities and resources of the RDA (The 2005 One NorthEast Corporate plan for the framework is yet to be published).

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[111] Sustainable Economic Performance, Regeneration, Urban, Rural, Physical development, Employment, Skills, Productivity, Enterprise, Investment and innovation.

4.9 Sectoral Composition of the UK economy

Prior to discussing the sectoral composition of the UK economy it is important to be aware different definitions of the growth of an economy. The three most commonly used measures of growth are:

1. Growth of output[112];
2. Growth of output per worker[113]; and
3. Growth of output per capita[114].

Evidently each measure of growth gives a different reading of a region's growth performance. That is to say a region may experience low output growth and rapid output per capita simultaneously if there is a significant net out migration of non-workers (see Chapter three section 3.4.1). In general there tends to be a high correlation between output growth and the growth in output per capita, but there is a much lower correlation between output per worker and the other two measures.

Therefore, it is important to be aware of which particular measure of growth is used as these three measures give quite different readings of a region's growth performance. The performance measure used throughout this thesis is that of output per worker. The reason for this choice are two fold first the Government uses output per worker as the central measure for assessing the productivity gap (as it can be immediately linked to the overall objectives or raising trend growth) and

[112] Is used as an indicator of the growth of productive capacity, which partly depends on the extent to which regions are attracting capital and labour from other regions.
[113] Is often used as an indicator of changes in a region's competitiveness (since it measures productivity growth).
[114] Is used as an indicator of changes in economic welfare and is nations output divided by total population therefore does not exclude unemployed and economic inactive persons.

secondly because it is the most straight forward to measure hence the least ambiguous.

As noted in Chapter three the Government is committed to its long term economic goal of raising the UK's rate of productivity growth, improving competitiveness and narrowing the productivity gap with its key competitors. Within the wider productivity agenda manufacturing has been identified to be a source of innovation in the economy and is also recognised to play an important role in raising productivity.

> *"Manufacturing matters. It comprises a fifth of the economy, it employs around 4 million people and many more associated industries and services. Manufacturing accounts for 60% of our exports and 80% of research and development, so is a driver of innovation and technology uptake. But manufacturing productivity in many other industrialised countries is higher than it is in the UK: around 30% more in France and Germany, and 55% more in the US. If the UK manufacturers could match performance of these countries, the UK would be £70bn better off."*
> DTI Manufacturing Strategy. The Government's response to the third report of the House of Commons Trade and Industry select committee CM 5578

This section will consider the industrial composition of the UK economy in relation to the two determinants of growth (as identified in the UK Treasury (2000a) report) employment and productivity. The primary reasons for examining manufacturing are two fold, firstly because historically manufacturing has seen faster productivity growth than any other sector and is seen as a driver of productivity and secondly the wealth of empirical and measurable data available. The two determinants of growth will now be briefly contextualised in relation to the UK economy.

Table 33: UK Share of Employment by industry (1991-2000)

UK Employment Share %	1991	1993	1995	1996	1997	1998	1999	2000
Agriculture	1.47	1.6	1.34	1.34	1.72	1.16	1.07	0.99
Fishing	0.03	0.04	0.03	0.03	0.03	0.05	0.04	0.03
Manufacturing	**17.42**	**16.21**	**16.46**	**16.48**	**16**	**14.84**	**14.03**	**13.31**
Electricity, gas & water	1.06	0.96	0.76	0.67	0.64	0.56	0.49	0.53
Construction	4.81	4.12	4.16	3.96	4.44	4.67	4.67	4.59
Distribution, hotels & catering	22.49	22.8	22.71	22.91	22.99	24.79	24.57	24.6
Transport & communications	6.4	6.27	6.04	5.99	5.88	5.9	6.08	6.18
Finance & business services	15.92	16.51	17.93	17.86	18.52	18.78	19.27	19.84
Government & other services	30.39	31.5	30.57	30.78	29.8	29.25	29.77	29.91

Adapted ABI

Table 33 illustrates the share of employment in various sectors in the UK economy from 1991-2000[115]. It becomes evident that the share of employment in *Manufacturing* has dropped, from 17.42% in 1991 to 13.31% in 2000. Conversely the share of employment in *Finance & business services* has increased from being 15.92% in 1991 to 19.84% in 2000. Throughout the period 1991-2000 those employed in the *Government & other services* sector have consistently accounted for the largest share of UK employment (an average employment share of 30%). It becomes evident from this table that the greatest loss in the share of employment has been in the *Manufacturing* sector of the economy as opposed to *Finance & Business services* sector which has gained in its share of UK employment.

Table 34: UK Share of Output by industry (1991-2000)

UK Output Share %	1991	1993	1995	1996	1997	1998	1999	2000
Agriculture	1.82	1.83	1.83	1.72	1.39	1.23	1.16	1.02
Fishing	0.06	0.07	0.07	0.07	0.06	0.06	0.06	0.05
Manufacturing	**18.61**	**18.01**	**19.08**	**18.85**	**18.57**	**17.5**	**16.57**	**15.86**
Electricity, gas & water	2.89	2.92	2.51	2.48	2.31	2.13	2.04	1.91
Construction	6.38	5.23	5.31	5.27	5.28	5.23	5.31	5.36
Distribution, hotels & catering	14.97	15.08	14.94	15.22	15.64	15.76	16.03	15.88
Transport & communications	8.7	8.33	8.26	8.15	8.23	8.32	8.33	8.37
Finance & business services	23.94	25.48	25.6	25.87	26.34	27.9	28.35	29.15
Government & other services	22.61	23.06	22.42	22.36	22.18	21.86	22.15	22.4

Note: Constant prices

Adapted: ONS, ABI

[115] See Appendix 5 for a detailed industry breakdown of UK output & employment shares which are based on the data set complied by the author as discussed in Chapter 5.

Table 34 shows the UK share of output by the broad industry sectors of the economy. In 1991 *Government & other services* (22.61%) and the *Finance & business services* (23.94%) sectors accounted for approximately 46% of total UK output. The *Finance & business services* sector has seen the greatest share increase in UK output from 23.94% in 1991 to 29.15% in 2000. In 2000 *Government & other services* accounted for 22.40% of total UK output and *Manufacturing* accounting for 15.86%. It becomes apparent that the *Finance & business services* industry has seen the greatest growth in output. It also shows that the industries, *Finance & business services, Government & other services, Distribution, Hotels & Catering* and *Manufacturing* have dominant shares of output.

Table 35: UK Share of employment and output by industry 2000

	Employment	Output
Agriculture	0.99	1.02
Fishing	0.03	0.05
Manufacturing	**13.31**	**15.86**
Electricity, gas & water	0.53	1.91
Construction	4.59	5.36
Distribution, hotels & catering	24.6	15.88
Transport & communications	6.18	8.37
Finance & business services	19.84	29.15
Government & other services	29.91	22.4

Source: Table 33 & Table 34

Furthermore, when comparing the share of employment and output (Table 35) it is interesting to note that *Manufacturing* and *Distribution, hotels & catering* sectors have similar output shares but the employment share of *Manufacturing* is almost half of that of the *Distribution, hotels & catering* sector. The employment share of *Government & other services* sectors is the highest of any other sector. The *Finance & business services* sector accounts for the highest share of output whilst its employment share is only fifth. The *Distribution, hotels & catering* industry has a big share of employment.

It therefore becomes evident that firstly there exists a relationship between employment and output. However this relationship is quite complex that is to say a high employment share does not automatically guarantee a high share of output and therefore high productivity. The relationship between employment, output and productivity are explored in depth in section 4.9.2 of this chapter.

4.9.1 UK Regional Annual Average Productivity Growth Rates

Prior to the discussion of sectoral annual average productivity growth rates it is important to point out that sector output weightings are not included in this discussion but are explored in section 4.9.2. Therefore caution is advised as a particular sector may reveal fast productivity growth but its share of output maybe minimum and vice-versa.

In forming economic development policies assessing sectoral structure and performance of a region is very important, i.e. which sectors are growing or declining in terms of volume activity, value added or share of labour demanded, and how these sectors are performing in terms of efficiency and productivity growth. Understanding, measuring and explaining productivity and its impact on the economy is important in its own right. However, there are further implications. A large or growing sector may be mistakenly seen as suitable for the region even if it may not be as efficient compared to the same sector in other regions, without consideration that sooner or later it will become less competitive and begin to diminish from external pressures. As an alternative a less dominant sector may be a better candidate for long term growth and development because of its competitive efficiency.

This section discusses the sectoral annual average growth rates of productivity[116] (output per worker) in order to understand how changes to the national industrial landscape compare with that of the various regions which make up the UK economy. In addition this allows us to compare and contrast national and regional drivers of productivity growth with regards to sectoral composition.

Table 36 and Table 37 illustrates the change in productivity growth for the period 1991-2000 for the manufacturing sub sectors and the total economy for the 12 regions of the UK. In both tables the shaded rows show a decline in a sector at the national level. When considering Table 36 the South East appears to have five manufacturing sub sectors which show the greatest productivity growth (well above the UK average) and in relation to its UK counterparts in sectors Textile & clothing(17-18), Leather (19), Rubber, & plastics products (25), Other manufacturing (36-37) and Total manufacturing (15-37). Furthermore, 10 of the 12 manufacturing sub sectors have shown productivity growth above the UK average. In comparison 9 of the 12 manufacturing sub sectors in Yorkshire & Humber reveals productivity growth below UK average. Three regions show 2 different manufacturing sub sectors (well below the UK average productivity growth in relation to its UK counterparts); the North East Other metals (29) and Electronic & optical (30-33); North West Textile & clothing (17-18); and Paper, printing & publishing; and Wales Basic metals (27-28) and Transport equipment (34-35).

In the *Basic metals* sector (27-28) eight of the 12 regions showed above average UK productivity growth and 10 of the 12 regions in *Paper, printing & publishing* sector (21-22) showed below average UK productivity growth. Only 5 of the 12 regions experience productivity

[116] Refer to Appendix 6 for the formula for calculating the annual average rates of growth. These calculations are based on the data set compiled by the author which is discussed in chapter five.

growth above the UK average with regards to *Total manufacturing* (15-37). The *Rubber & plastic products* sector (25) was the only manufacturing sub sector which showed a decline in productivity growth at the UK level. Yorkshire & Humber showed the fastest productivity growth in *Rubber & plastic products* sector (25) whereas the North East showed the biggest decline in comparison to the other regions for the same sector.

Table 36: Average Annual Productivity Growth Rates - Manufacturing Sub Sectors 1991-2000

		UK	NE	NW	Y&H	EM	WM	E	L	SE	SW	W	S	NI
17-18	Textile & clothing	**2.21**	1.83	0.59	1.06	1.58	3.25	5.46	3.97	5.69	5.09	3.89	1.72	1.46
19	Leather	**1.43**	0	1.86	-0.98	1.77	-0.99	2.33	-4.41	8.71	6.44	1.26	-5.61	-3.9
20	Wood & wood products	**0.74**	2.35	2.1	-2.47	-0.13	-0.38	16.87	2.01	-0.75	0.18	-1.58	0.02	-2.89
21+22	Paper, printing & publishing	**2.32**	2.46	0.05	1.92	1.36	1.4	2.15	2.77	3.51	1.93	0.5	1.38	1.8
24	Chemical & man-made fibres	**2.01**	4.01	1.07	-1.77	-0.03	2.37	1.43	4.44	2.1	2.98	3.37	3.12	1.55
25	Rubber & plastic products	**-0.48**	-5.02	0.33	1.33	-0.89	0.58	-2.44	-2.33	-0.99	-0.32	-0.03	-1.34	1.12
26	Non-metallic mineral products	**3.21**	2.48	2.99	3.19	3.38	3.28	4.11	4.33	4.44	-2.42	3.52	3.25	-0.13
27-28	Basic metals	**2.05**	2.05	4.34	2.43	1.68	-0.32	0.54	2.87	3.28	2.5	-0.97	6.05	3.48
29	Other metals	**3.49**	-0.32	3.14	1.5	2.65	4.49	5.06	3.17	4.5	4.77	6.33	0.95	5.33
30-33	Electronic & optical	**2.46**	-1.5	2.5	3.48	1.6	2.07	1.74	1.89	2.72	4.06	-0.03	2.45	5.43
34-35	Transport equipment	**1.35**	4.14	-0.72	0.49	3.44	1.29	-0.74	0.42	2.5	2.87	-0.84	4.44	2.15
36-37	Other manufacturing	**3.4**	1.87	4.04	4.74	4.19	6.64	0.03	0.68	8.74	1.33	3.74	2.18	1.8
15-37	Total manufacturing	**2.27**	1.45	-0.35	1.68	2.19	1.78	1.62	2.67	3.03	2.83	0.75	2.97	2.79

Source: Author's calculations

Table 37 below shows the productivity growth of regions over time in the various sectors which make up the total economy. Of the 13 sectors which makeup the total economy three sectors depicted a decline at the UK level; *Agriculture, Hunting & forestry* (01+02), *Construction* (45) and *Public administration & defence* (75). When considering the remaining 10 sectors an increase in average UK productivity growth was apparent with *Electricity, gas & water supply* sector (40-41) which achieved the fastest productivity growth. In the East of England region 9 of the 10 sectors depicted productivity growth below the UK average, followed by Northern Ireland where 7 sectors above the UK average. Seven sectors[117] in Northern Ireland achieved above average UK productivity growth. The North East experienced the slowest average UK productivity growth in three sectors[118] (the most in relation to the other 12 regions). The North East experienced the slowest productivity growth of the total economy as a whole in relation to its UK counterparts. The North East, North West, East Midlands and Scotland all had two different sectors which achieved the lowest productivity growth in relation to the other regions. In comparison the total economy of Northern Ireland showed the highest productivity growth in contrast to the UK as a whole and the other UK regions. Also 5 of the 10 sectors depicted productivity growth well above the UK average and in relation to its UK counterparts.

When considering the *Health & social work* sector (85), 10 of the 12 regions experienced below average UK productivity growth. The *Real estate, renting & business activities* sector (70-74) was the only sector in which 8 of the 12 regions achieved higher productivity growth than the UK average with Northern Ireland showing the highest productivity growth.

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[117] Manufacturing (15-37), Electricity, gas & water supply (40-41), Wholesale & retail trade (50-52), Transport, storage & communications (60-64), Financial intermediation (65-67), Real estate, renting & business activities (70-74) and Private households with employed persons (90-93).

[118] Electricity, gas & water supply (40-41), Wholesale & retail trade (50-52) and Transport storage and communications (60-64).

Table 37: Average annual Productivity Growth Rates - Total Economy 1991-2000

		UK	NE	NW	Y&H	EM	WM	E	L	SE	SW	W	S	NI
01 + 02	Agriculture, hunting & forestry	-1.06	0.06	0.3	1.12	-0.95	0.25	-1.47	-17.44	-2.15	1.95	2.57	-6.27	-4.74
15-37	Manufacturing	2.27	1.45	-0.35	1.68	2.19	1.78	1.62	2.67	3.03	2.83	0.75	2.97	2.79
40-41	Electricity, gas and water supply	4.21	1.53	4.02	6.67	3.83	1.77	2.62	5.14	6.27	5.8	1.63	5.82	4.23
45	Construction	-0.41	-1.1	-0.47	0.93	-0.43	1.4	-1.62	-0.52	-1.58	-2.87	-2.01	0.67	2.78
50-52	Wholesale & retail trade	0.5	-0.7	0.85	0.44	0.86	0.41	0.07	0.06	0.78	-0.42	0.36	0.56	1.4
55	Hotels & restaurants	1.73	2.05	-1.2	1.59	0.53	3.04	1.26	0.29	0.43	1.67	4.33	1.18	-0.33
60-64	Transport, storage and communications	1	-0.1	0.77	0.11	0.33	0.21	0.61	1.76	1.26	0.65	1.08	0.74	1.96
65-67	Financial intermediation	1.83	2.05	2.19	1.98	2.81	1.86	1.21	1.55	2.26	2.36	0.55	0.08	4.84
70-74	Real estate, renting and business activities	0.24	0.86	0.99	-1.06	-1.12	0.36	-0.16	-0.27	0.07	0.48	0.27	-0.55	1.3
75	Public administration & defence	-0.85	-0.95	0.25	-0.66	-1.01	-0.51	1.05	-1.18	-0.19	-1.19	-0.45	0.19	-1.98
80	Education	1.4	1.44	1.44	0.68	4.5	0.86	2.68	0.61	1.05	0.74	1.02	-0.8	1.34
85	Health & social work	2.16	1.58	2.81	2.86	1.86	2.09	1.26	2	1.97	1.99	1.97	0.88	0.07
90-93	Private households with employed persons	2.13	0.89	3.04	1.12	0.04	1.1	0.71	2.79	0.71	1.61	2.26	1.82	12.83
	Total Economy	1.05	0.44	0.68	0.68	0.92	1.06	0.62	0.94	1.12	0.67	0.65	0.57	1.27

Source: Author's calculations

Three sectors showed a decline at the UK level; *Agriculture, hunting & forestry* (01+02), *Construction* (45) and *Public administration & defence* (75). London showed the greatest decline in the *Agriculture, hunting & forestry* sector (01+02) whereas Wales showed the greatest increase in productivity growth for that same sector. The *Construction* sector (45) in the South West showed the greatest decline as opposed to Northern Ireland which showed the largest productivity growth over time for the period 1991-2000. In the *Public administration & defence* sector (75) Northern Ireland depicted the greatest decline and the East of England region saw the highest productivity growth. Table 36 and Table 37 show the extent of inter-sectoral differences in productivity growth rates between regions. Inter-sector differences can be explained by partly by the relative importance of various sectors and by exogenous regional characteristics such as the skills composition of the workforce (see Chapter three).

Table 38 and Table 39 compares the national and regional (North East) drivers of productivity. The results in Table 38 and Table 39 are organised in ascending order and do not take into account the share weightings of sectors. At this point it is important to note that the shaded areas represent sectors which have depicted a decline. However in some instances the shaded area represents where there is no regional data available. When considering Table 38 below it soon becomes apparent the *Non-metallic mineral products* (26), *Other manufacturing* (36-37) and *Other metals* (29) sector at the national level which have shown the fastest productivity growth. The sectors *Chemical & man-made fibres* (24) and *Transport equipment* (34+35) have shown the fastest productivity growth for the North East. The manufacturing sector nationally as a whole has shown a productivity growth rate of 2.27% as opposed to the North East which has yielded a productivity growth of 1.45%. However, as highlighted at the beginning of this subsection this discussion has been confined to the rate of productivity growth which does not take into account the sectoral output weightings.

Table 38: Average annual rate of productivity growth (Manufacturing sub sectors – 1991-2000)

UK			NE		
25	Rubber & plastic products	-0.48	25	Rubber & plastic products	-5.02
20	Wood & wood products	0.74	30-33	Electronic & optical	-1.5
34-35	Transport equipment	1.35	29	Other metals	-0.32
19	Leather	1.43	19	Leather	0
24	Chemical & man-made fibres	2.01	15-37	Total manufacturing	1.45
27-28	Basic metals	2.05	17-18	Textile & clothing	1.83
17-18	Textile & clothing	2.21	36-37	Other manufacturing	1.87
15-37	Total manufacturing	2.27	27-28	Basic metals	2.05
21-22	Paper, printing & publishing	2.32	20	Wood & wood products	2.35
30-33	Electronic & optical	2.46	21-22	Paper, printing & publishing	2.46
26	Non-metallic mineral products	3.21	26	Non-metallic mineral products	2.48
36-37	Other manufacturing	3.4	24	Chemical & man-made fibres	4.01
29	Other metals	3.49	34-35	Transport equipment	4.14

Source: Table 36

Upon comparison of the results for the total economy and total manufacturing the fastest productivity growth nationally has been in the *Electricity, gas & water supply* sector (40-41) (Table 39). In contrast the *Financial intermediation* (65-67) and *Hotels & restaurants* (55) sectors have the fastest productivity growth in the North East. Even more interesting is that the *Other metals* sector (29) shows the fastest productivity at the national level as opposed to the North East region which shows a decline. The *Basic metals* sector (27-28) was the only sector where the North East and the UK grew at the same level. Of the 9 sectors which show productivity growth for the North East only 4 sectors[119] have above average UK growth. The other 4 sectors[120] show below average UK

[119] Wood & wood products (20), Paper, printing & publishing (21-22), Chemical & man-made fibres (24) and Transport equipment (34-35).
[120] Total manufacturing (15-37), Textile & clothing (17-18), Other manufacturing (36-37), Non-metallic mineral products (26).

productivity growth. The remaining *Basic metals* sector (27-28) as noted earlier showed productivity growth was equal to the national growth. Three sectors depicted a decline in productivity growth opposed to only one sector on the national level as can be seen by the shaded areas.

Table 39: Average annual rates of productivity (Total economy – 1991-2000)

UK			NE		
01-02	Agriculture, hunting & forestry	-1.06	45	Construction	-1.1
75	Public administration & defence	-0.85	75	Public administration & defence	-0.95
45	Construction	-0.41	50-52	Wholesale & retail trade	-0.7
70-74	Real estate, renting and business activities	0.24	60-64	Transport, storage and communications	-0.1
50-52	Wholesale & retail trade	0.5	01-02	Agriculture, hunting & forestry	0.06
60-64	Transport, storage and communications	1		Total Economy	0.44
	Total Economy	1.05	70-74	Real estate, renting and business activities	0.86
80	Education	1.4	90-93	Private households with employed persons	0.89
55	Hotels & restaurants	1.73	80	Education	1.44
65-67	Financial intermediation	1.83	15-37	Manufacturing	1.45
90-93	Private households with employed persons	2.13	40-41	Electricity, gas and water supply	1.53
85	Health & social work	2.16	85	Health & social work	1.58
15-37	Manufacturing	2.27	65-67	Financial intermediation	2.05
40-41	Electricity, gas and water supply	4.21	55	Hotels & restaurants	2.05

Source: Table 37

Of the 9 sectors showing positive productivity growth for the North East, only 5 sectors[121] show above average UK productivity growth. The remaining 4 sectors[122] depict the contrary. More interestingly, total manufacturing depicted the second fastest productivity growth at the national level as opposed to the North East. This implies that manufacturing is still important in terms of productivity growth at the national level. These productivity growth rates are later ranked at

121 Agriculture, hunting & forestry (01+02), Real estates, renting & business activities (70-74), Education (80), Financial intermediation (65-67), Hotels & restaurants (55).

122 Private households with employed persons (90-93), Total manufacturing (15-37), Electricity, gas & water supply (40-41), Health & social work (85).

national and regional level, applied to a technique called Spearman Rank Correlation Coefficient which is discussed in Chapter four (section 4.9).

4.9.2 The link between employment and productivity

The relationship between employment and productivity was briefly introduced in Chapter three section 3.3. This section will explore the trade offs between employment and productivity. The link between employment, productivity and aggregate output are linked to each other as follows:

$$Output = Employment \times Productivity$$

The equation means that any given level of output can be achieved either with high productivity and low employment (where the employment intensity of economic growth is said to be low) or conversely, with low productivity and high employment (a high employment intensity). One of the most frequent cited effects associated with productivity gains is the loss of jobs and four general points can be made:

1) There is a range of productivity sources that may have no direct or indirect effect on reducing the level of employment. Increases in product quality, greater capacity utilisation, the more efficient use of materials and the better organization, training and treatment of labour are changes that can increase productivity without causing declines in employment levels i.e. increasing value added.

2) A productivity increase that leads to expanded market share and therefore employment creation at the enterprise or country level can prompt an employment decrease in competing enterprises and in other countries. This is the displacement effect and would need to be factored into any analysis of net employment effects. Countries are constantly concerned with the loss of industry competitiveness and market shares

because of their effects on employment and output. But in this instance increasing competitiveness is associated with job losses.

3) Productivity increases based on technological mechanisation and robotic adaption can reduce the demand for labour. At the enterprise level the net employment effect will be determined by market demand. More specifically it will depend on whether the reduced demand for labour in per unit output is offset by an increase in labour demand due to output expansion.

4) A decrease in labour demand due to productivity increase maybe offset by increased demand for labour in the same or other sectors, as a result of the creation of new products and the expansion of markets. In developed countries for example the decline in rural employment due to technological tractorizaton and other advances was offset by increased demand for workers in urban manufacturing and services.

Thus the immediate impact of productivity gains can lead to labour displacement in one sector and over the longer term the market can compensate with gains in another sector, depending on the evolution of the product demand and output expansion. The relationship between employment and productivity is based on generalisations concerning trade-offs that occur often but not always in the short run between these two variables in a given sector. A more robust evaluation of the relationship between employment and productivity growth has to be sensitive to the time frame considered and the ways in which the markets, actors, institutions respond to the growth of productivity. Such 'compensatory mechanisms[123]' and their interaction are vital to an

[123] for a more detailed discussion of compensatory mechanisms, see Pianta, 2000; Spezia & Vivarelli, 2002; Vivarelli, 1995.

understanding of how productivity growth at one location in an economy affects employment and output at the aggregate level.

Output & employment growth rates

Prior to discussing and analysing sectoral output and employment annual average growth rates (1991-2000) and weightings (2000) for the UK and the North East a distinction must be made between three different processes; innovation, efficiency and diffusion. Firstly, productivity growth can result from innovative capacity. Secondly, productivity growth may be due to reduced (technical) inefficiency, implying that an inefficient firm or industry uses more resources and factor inputs than required by a particular technology, therefore tying resources to low productivity activities reducing the overall allocative efficiency of an economy. Exposure to a higher level of competition forces inefficient firms to restructure, freeing resources for other productive resources.

A third process is technological diffusion. Firms can improve productivity by adopting production processes and products developed elsewhere (imitation). This allows them to improve productivity in a relatively straight forward way as they do not engage in often costly innovative activity. Diffusion differs conceptually from efficiency gains as the latter relates to improvements made in using a given technology even when the technology is outdated by international standards. Diffusion relates to the ability of regions with low productivity levels and/or low level technology to incorporate the stock of technology developed in more advanced economies (i.e. catch up). All three processes are influenced by competitive conditions.

Prior to the discussion of Table 40 and Table 42 it is important to note that the tables do not capture the contribution of the informal economy[124] hence the dynamics of structural change are not prevalent. With respect to productivity and employment trade-offs the informal economy is typically biased towards employment growth at the expense of productivity growth. Consequently the informal economy is characterised by substantial economic activity and substantial underemployment. The informal economy is also heavily biased towards unskilled labour. Despite these drawbacks it has become increasingly recognised that small scale enterprise characteristic of the informal economy has substantial growth potential. Informal small scale enterprises provide many jobs and are an important source of income as they are easy to start up and rely primarily on unskilled labour. Furthermore, they are a source of capital formation for small entrepreneurs facilitating small scale entrepreneurship by reducing entrance costs for informal economy workers and can be considered a labour biased development strategy to offset the distortionary tendencies (underemployment) of capital-biased technological change. Additionally, self employed workers comprise the majority of employment in the informal economy.

Table 40 and Table 42 compares the annual average employment, output and productivity growth rates of the UK with the North East for the period 1991-2000 as well as the percentage output and employment weights (represented by the italicised figures) for 2000. Refer to

[124] Labour statisticians define the informal economy as a group of production units which form part of the household sector as household enterprises or equivalently, as unincorporated enterprises owned by households within the household sector, the informal economy comprises, i) informal own account enterprises that is owned and operated by own account workers either alone or in partnership with members of the same or other households, which may employ contributing family workers and employees on an occasional basis but do not employ employees on a continuing basis; and ii) enterprise of informal employers that are owned and operated by employers alone or in partnership with members of the same or other households which employs one or more employees on a continuous basis.

Appendix 7 for the annual average output and employment growth rates of the UK regional counterparts. The relationship between output and employment growth rates can be seen in Table 40 and Table 42. Both these tables show that in certain sectors as employment declines output increases. Also as employment declines so does output which both effect productivity.

The importance of regional weightings as highlighted earlier is that a fast output or productivity growth rate of a sector whose share of output is small does not substantially affect output and vice-versa. For example for the UK the manufacturing sub-sector *36-37* showed the fastest output growth of 5.89% but its share of output in 2000 was 4.88% (Table 40). Conversely for the UK the sector *27-29* showed the third slowest output growth (manufacturing sub sectors) of 0.15% but accounts for 12.49% of UK manufacturing sub sector output (Table 40). (see Appendix 8 for regional output & employment industry shares for manufacturing sub sectors and Appendix 9 for the total economy).

Table 40: Annual average output, employment and productivity growth rates (Manufacturing sub sectors 1991-2000) and sectoral weights (2000)

		OUTPUT				EMPLOYMENT				PRODUCTIVITY*	
		UK		NE		UK		NE		UK	NE
17-18	Textile & clothing	-2.57	*4.59*	-5.79	*3.6*	-4.68	*7.24*	-7.49	*5.8*	2.11	1.7
19	Leather	-7.25	*0.52*	-4.47	*0.18*	-8.56	*0.66*	0	*0*	1.31	-4.47
20	Wood & wood products	0.76	*1.75*	-0.14	*1.97*	0.02	*2.44*	-2.43	*2.59*	0.74	2.29
21-22	Paper, printing & publishing	2.17	*15.86*	-0.54	*8.77*	-0.14	*13.51*	-2.93	*7.68*	2.31	2.39
24	Chemical & man-made fibres	0.17	*11.85*	-1.53	*19.5*	-1.81	*6.97*	-5.32	*10.84*	1.98	3.79
25	Rubber & plastic products	1.69	*5.97*	1.61	*7.37*	2.18	*6.89*	6.98	*8.81*	-0.49	-5.37
26	Non-metallic mineral products	0.5	*3.93*	-1.36	*3.1*	-2.62	*4.02*	-3.75	*3.26*	3.12	2.39
27-28	Basic metals	0.15	*12.49*	-1.2	*14.84*	-1.86	*14.93*	-3.18	*18.63*	2.01	1.98
29	Other metals	0.49	*9.45*	-1.91	*11.57*	-2.9	*10.56*	-1.6	*12.05*	3.39	-0.31
30-33	Electronic & optical	2.61	*16.73*	0.09	*12.08*	0.14	*14.53*	1.62	*12.9*	2.47	-1.53
34-35	Transport equipment	0.88	*11.97*	4.15	*12.9*	-0.47	*11.84*	0.02	*11.12*	1.35	4.13
36-37	Other manufacturing	5.89	*4.88*	4.24	*4.13*	2.41	*6.41*	2.32	*6.3*	3.48	1.92

*Productivity growth rates are calculated by subtracting output from employment
NOTE: The figures in italics represent sector weightings in 2000

Source: Appendices 5, 7 & 8 and Author's calculations

The employment and output growth rates can be broken into three distinct categories. The first category shows an output gain and an employment loss, the second category shows and output gain and an employment gain and the final category which shows an output loss and an employment loss.

Table 41: Employment and output growth rate categories (Manufacturing sub sectors)

	NE	UK
Output gain & employment loss		21-22 - *Paper, printing & publishing* 24 - *Chemical & man-made fibres* 26 - *Non-metallic mineral products* 27-28 - *Basic metals* 29 - *Other metals* 34-35 - *Transport equipment*
Output gain & employment gain	25 - *Rubber & plastic products* 30-33 - *Electronic & optical* 34-35 - *Transport equipment* 36-37 - *Other manufacturing*	20 - *Wood & wood products* 25 - *Rubber & plastic products* 30-33 - *Electronic & optical* 36-37 - *Other manufacturing*
Output loss & employment loss	17-18 - *Textile & clothing* 20 - *Wood & wood products* 21-22 - *Paper, printing & publishing* 24 - *Chemical & man-made fibres* 26 - *Non-metallic mineral products* 27-28 - *Basic metals* 29 - *Other metals*	17-18 - *Textile & clothing* 19 - *Leather*

Source: Table 40

Based on Table 40 & Table 41 shows six (*21-22, 24, 26, 27+28,29, 34-35*) of the 12 sectors showed an output gain and an employment loss for the UK as opposed to no sectors in the North East. The UK and the North East showed an employment and output gain for sectors *25, 30-33, 36-37*. The North East also showed an employment and output gain for sector *34-35* as opposed to the UK. Of the 11 sectors (excluding sector 19) seven sectors (*17-18, 20, 21-22, 24, 26, 27-28, 29*) in the North East showed an output and employment loss as opposed to only two sectors (17-18 & 19) as the UK level.

For the UK sector *36-37* experienced the fastest output (5.89) and employment (2.41) growth rate as opposed to sector 19 experiencing the slowest output growth (-7.25) and the greatest employment (-8.56) decline. Even though sector 34-37 showed the fastest growth for the UK its sector output weighting was only 4.88%. Sector *30-33* had the greatest output share (16.79%) and the second biggest share of employment (14.53%) and the second fastest output growth (2.61).

The North East experienced the fastest output growth in sector *36-37 (*4.24%*)* and employment growth in sector *25* (6.98%). On the other hand the North East experienced the slowest output and employment growth in sector *17-18*. The output share of sector *36-37* was only 4.13%, even though it experienced the fastest output growth. Sector *27-28* in the North East had the highest output share (14.84%) but showed a decline output growth (-1.2%).

The growth effects of employment shifts between sectors are as significant as the growth within sectors (see Baily *et al.*, 1992; Pieper, 2001; Piacentini & Pini, 2000) hence sectoral shares are important. In the UK as well as the rest of the world a shift in employment has been taking place – away from agriculture towards non-agricultural sectors. The increase in sectoral employment has been most dramatic in the service sector which accounts for over two thirds of employment in developed economies and between 10 and 80 per cent (and rising) in developing economies. However, caution is advised with regards to the quality of jobs. Productivity and employment growth have been increasing rapidly in some of the service industries leading to a win-win situation for the economy as a whole.

Table 42: Annual average output and employment growth rates (Total economy 1991-2000) and sectoral weights (2000)

		OUTPUT				EMPLOYMENT				PRODUCTIVITY*	
		UK		NE		UK		NE		UK	NE
01+02	Agriculture, hunting & forestry	-3.56	*1.02*	-3.12	*0.61*	-2.53	*0.99*	-3.18	*0.51*	-1.03	0.06
15-37	Manufacturing	1.09	*15.86*	-0.43	*21.42*	-1.16	*13.31*	-1.85	*15.91*	2.25	1.42
40-41	Electricity, gas and water supply	-1.71	*1.91*	2.53	*2.88*	-5.68	*0.53*	0.98	*0.79*	3.97	1.55
45	Construction	0.91	*5.36*	-1.27	*5.75*	1.33	*4.59*	-0.17	*5.95*	-0.42	-1.1
50-52	Wholesale & retail trade	3.18	*12.44*	1.17	*10.96*	2.67	*18.07*	1.88	*16.67*	0.51	-0.71
55	Hotels & restaurants	5.16	*3.44*	4.35	*3.26*	3.38	*6.53*	2.26	*6.27*	1.78	2.09
60-64	Transport, storage and communications	2.46	*8.37*	-0.23	*7.22*	1.44	*6.18*	-0.13	*5.05*	1.02	-0.1
65-67	Financial intermediation	2.3	*5.57*	0.46	*3.3*	0.46	*4.26*	-1.57	*2.2*	1.84	2.03
70-74	Real estate, renting and business activities	5.99	*23.58*	3.46	*17.67*	5.74	*15.58*	2.57	*10.7*	0.25	0.89
75	Public administration & defence	-1.19	*4.85*	-1.38	*5.64*	-0.35	*5.59*	-0.43	*7.38*	-0.84	-0.95
80	Education	3.64	*5.98*	1.63	*7.49*	2.2	*8.47*	0.18	*9.29*	1.44	1.45
85	Health & social work	3.68	*6.87*	4.14	*9.49*	1.48	*10.79*	2.52	*13.67*	2.2	1.62
90-93	Private households with employed persons	6.04	*4.7*	4.66	*4.25*	3.83	*5.06*	3.73	*5.6*	2.21	0.93
	Total Economy	2.9		1.2		1.84		0.76		1.06	0.44

* Productivity growth rates are calculated by subtracting output from employment
NOTE: The figures in italics represent sector weightings in 2000

Source Appendices 5, 7 & 9 and Author's calculations

Table 42 & Table 43 show one sector for both UK (*15-37*) and the North East (*65-67*) which experienced an output gain and an employment loss. Of the 13 sectors which makeup the total economy six sectors (*50-52, 55, 70-74, 80, 85, 90-93*) in both the UK and North East showed an output and employment gain as did the total national and regional economy. In addition to the six sectors the UK experienced an output and employment gain in three other sectors (*45, 60-64 & 65-67*) whereas the North East in one sector (*40-41*). The North East showed an employment and output loss in five sectors (*01-02, 45, 60-64, 75 & 15-37*) as opposed to the UK in three sectors (*01-02-40-41 & 75*).

Table 43: Employment and output growth rate categories (Total Economy)

	NE	UK
Output gain & employment loss	65-67 - *Financial intermediation*	15-37 - *Manufacturing*
Output gain & employment gain	40-41 - *Electricity, gas and water supply* 50-52 - *Wholesale & retail trade* 55 - *Hotels & restaurants* 70-74 - *Real estate, renting and business activities* 80 - *Education* 85 - *Health & social work* 90-93 - *Private households with employed persons* Total economy	45 - *Construction* 50-52 - *Wholesale & retail trade* 55 - *Hotels & restaurants* 60-64 - *Transport, storage and communications* 65-67 - *Financial intermediation* 70-74 - *Real estate, renting and business activities* 80 - *Education* 85 - *Health & social work* 90-93 - *Private households with employed persons* Total economy
Output loss & employment loss	01-02 - *Agriculture, hunting & forestry* 45 - *Construction* 60-64 - *Transport, storage and communications* 75 - *Public administration & defence* 15-37 - *Manufacturing*	01-02 - *Agriculture, hunting & forestry* 40-41 - *Electricity, gas and water supply* 75 - *Public administration & defence*

Source: Table 42

Of the sectors which makeup the total economy for the UK sector *90-93* experienced the fastest output (6.04) growth as opposed to sector *01-02* which experienced a decline in output growth (-3.56). Sector *90-93* accounted for only 4.7% of output despite its fast output growth whilst sector *01-02* accounted for the smallest share of output (1.02%). Sector *70-74* showed the highest output share (23.58%) an employment (15.58%) share whereas sector *01-02* showing the greatest decline (-3.56). Sector *50-52* showed the highest employment share (18.07%) as opposed to sector *40-41* showing the smallest employment share (0.51%).

The North East economy experienced the fastest output (4.66) and employment (3.73) growth in sector *90-93*. However the sector weightings for output (4.7%) and employment (4.25) were approximately 4.5%. Sector *01-02* showed a decline in output (-3.12) and employment (-3.18). Sector *15-37* in the North East showed the greatest share of output (21.42%) as opposed to sector 01-02 (0.61%). Sector *50-52* showed the highest employment share (16.67%) whereas sector *01-02* showed the smallest employment share (0.51%).

The economy as a whole for the UK showed a growth in output (2.9%) and employment (1.84%). The North East regional economy also showed a growth in employment (0.76%) and output (1.2%) but growth was slower. The UK showed productivity growth of 1.06% whereas as the North East showed a much slower productivity growth rate (0.44).

Manufacturing as a whole for the UK showed a growth in output and a decline in employment as opposed to the North East which showed a decline in employment and output growth. Manufacturing accounted for 15.86% of total UK output and 13.31% of UK employment in 2000 whereas for the North East these shares were higher with manufacturing representing 21.42% of regional output and employment accounting for 15.91%.

Conclusion

The Government is committed to its long term economic goal of raising the UK's rate of productivity growth, improving competitiveness and narrowing the productivity gap with its key competitors. Within the wider productivity agenda manufacturing has been identified to be a key source of innovation in the economy and to play an important role in raising productivity.

This chapter was divided into three distinct sections the first part of this chapter reviewed the three dominant perspectives associated with the role of manufacturing in economic growth; the first where manufacturing is seen as an 'engine of growth'. The second perspective which regards de-industrialisation as an inevitable process of evolution. Section 3.3.1 revealed how the proportion of output and employment accounted for by manufacturing as a percentage of GDP had fallen during the 1973-1997. The final perspective that has attracted much attention since the late 1990s brought about by an increased flow of goods, services, money, and ideas across national borders and the subsequent integration of the global economy commonly referred to as globalisation. According to the final perspective the management of the supply chain, together with where R&D and innovation takes place has become more important than the actual location of production. The acceleration of US productivity since 1996 through to 2000 is well documented and widely understood. The source of the productivity resurgence in the US is traced to the sectors of the economy that produce information technology (IT) or use IT equipment and software intensively (Bailey, 2001).

The second part of this chapter discussed the 1997 Labour Government's view about the role of manufacturing. Much of the debate surrounding the UK 'productivity gap' has focussed on the performance of manufacturing in relation to the UKs international competitors. Manufacturing is considered to play a key role in raising UK productivity and narrowing the productivity gap with its main competitors over the next decade. The 1997 Labour administration is behind the need for a strong manufacturing base. Thereafter this chapter discussed the regional economic strategy published by the North East regional development agency which focuses heavily on cluster development of 14 sectors. The manufacturing sector is integrated within the North East regional economic strategy primarily driven by the national ambitions of driving UK productivity. The emphasis of manufacturing within the regional economic strategy of the North East is also driven by manufacturing accounting for a greater proportion of employment and economic output than the UK as a whole.

The final part of this chapter discussed the sectoral composition of the UK economy with regards to employment and output and the interrelationship. The sectoral annual average productivity growth rates of the North East were compared to that of the UK where the slow productivity growth performance of the North East regional economy was established relative to its regional counterparts (Table 37). Table 42 showed manufacturing in the UK to account for 15.86% of output and 13.31% employment whilst in the North East manufacturing accounted for a higher proportion of both output (21.42%) and employment (15.91%). Despite manufacturing accounting for a greater share of employment and output in the North East its productivity growth rate (1.42%) was lower than the UK (2.25%).

A majority of the manufacturing sub-sectors for the North East showed a decline in output and employment as opposed to the UK which showed a growth in output and employment. Manufacturing as a whole for the North East showed a decline in employment and output opposed to the UK showing an increase in output growth and decline in employment. The North East regional economy as a whole showed slower growth in output and employment than the UK.

Chapter 5: Data & Methodology

Introduction

An overview of the major theoretical schools which either explicitly or indirectly explain the phenomena of regional growth differences was provided in Chapter two. These schools of thought can be broadly divided into three categories: the neo-classical models stress the supply side of economic theory. The Keynesian type models stress the importance of demand for regional exports in the growth process; and finally the cumulative causation models stress the self perpetuating nature of the growth process. Chapter two also provided an insight into the wide array of determinants of regional growth which influence the growth process, of which the sectoral/industrial structure one factor is. As manufacturing is a prominent feature of the North East regional economy the discussion henceforth will be confined to this particular determinant of growth (sectoral/industrial structure).

It was also noted in Chapter two that differences in labour productivity may also be a result of structural differences, i.e. differences in the structural composition of output within a particular industry or sector. According to early development economists (Tobin, 1985., Rostow, 1963) and most notably the "Fisher-Clark Hypothesis[125]" the sectoral and industrial composition of a region is an important element for its growth performance. Supported by the McKinsey studies (McKinsey, 1993) whereby the industrial structure for some regions plays an important

[125] See Chapter 4 section 4.2.2.

role. This view was endorsed by HMT & DTI report (2001) which maintains that UK regions vary in their industrial composition.

> *"The southern parts of the UK are relatively more specialised in service sector activities, whilst northern regions rely more heavily on manufacturing."* (HMT & DTI, 2001, pp. 20)

The mix of different industries in a region is associated with the skills, investment and technology requirements of that region. Therefore, the industrial composition is likely to be an important element in understanding regional and local economic dynamics.

> *"There is as yet no extensive academic work on the issue of industrial composition and productivity growth at the regional level."* (HMT & DTI, 2001, pp. 20)

The above cited quote will inform the empirical investigation that this thesis seeks to explore which is further underpinned by the research proposition derived in Chapter two. The empirical investigation aims to access whether the industrial composition of the North East region is a major explanation of its slow growth process and access whether regional inequality gaps are widening or narrowing over time. The nine principal hypotheses, set out below are developed to explore the initial research proposition, which this chapter will examine.

> *H1: The North East's industry mix does not explain the difference between national and regional employment change.*
> *H2: The North East's industry mix does not explain the difference between national and regional output per worker.*
> *H3: k sets of ranking are dependent*
> *H4: k sets of rankings are independent*

H5: Comparing regions, there is no variation in the dispersion of productivity levels over time

H6: Comparing sectors, there is no variation in the dispersion of productivity levels over time

H7: No variation of inequality within and between regions over time

H8: No variation of inequality within and between sectors over time.

H9: Perfect equality in productivity levels amongst the North East's sectors.

Each principal hypothesis is further underpinned by two sub hypotheses. This chapter will set out methods for testing these hypotheses. The methods will be discussed and critiqued in depth and the results obtained will be discussed in subsequent chapters. Prior to the discussion of these methods this chapter will begin by defining productivity and the various measures of productivity. Thereafter, the data sources and then the methodology which underpins the various propositions and hypotheses will be introduced in this chapter. At this point, it is important to note that this chapter will be purely descriptive, in terms of explaining of the methods as well as providing a comprehensive critique associated with the use of such methods.

5.1 Defining Productivity

As noted in the previous chapters the UK Government has committed to policies to improve the trend rate of growth, within which it has placed the pursuit of productivity as a top priority (HMT, 2000a). Chapter three, section 3.1 briefly introduced, how the growth of real output of an economy is measured over time. To reiterate, the output of an economy is usually measured by an increase in real Gross National Product (GNP) or Gross Domestic Product (GDP) over time.

Before the introduction of the 1995 European System of Accounts (ESA95), GDP was measured from the production side, the total across industries, was termed 'GDP at factor cost' and this excluded all indirect taxes. When GDP was measured from the expenditure side, the total was termed 'GDP at market prices' and this included indirect taxes. The difference between the two measures was termed the 'factor cost adjustment'.

Under the ESA95, the term 'GDP at factor cost' is no longer used. Instead value-added is measured at 'basic prices', a similar concept but not identical to GDP at factor cost. Value added at basic prices excludes 'taxes on products' (mainly VAT and excise duties which are output volume related), but does not exclude 'other taxes on production' (e.g. business rates which are not output sensitive). The total across industries is termed 'gross value added at basic prices' or GVA for short. This concept has replaced that of GDP at factor cost. GVA per hour or GVA per worker are two such measures that allows us to measure productivity.

Thus the levels of prosperity or living standards are not considered the same as the levels of productivity. GDP per head (the usual measure of living standards) which refers to the resident population is the result of output per person (labour productivity) and employment. Measuring labour productivity helps to understand the development of living standards. The relationship between GDP and GVA[126] at a national level is simply:

GDP at market prices = GVA at basic prices + all taxes, less subsidies, on products.

[126] In the UK GVA is used in the estimation of GDP which is a key indicator of the state of the whole economy. Three theoretical approaches are used to estimate GDP: 'production', 'income' and 'expenditure.'

5.2 Measuring Productivity

The OECD Productivity Manual published in March 2001 defines productivity as a ratio of a volume measure of output to a volume measure of input use. In other words it refers to how well an economy uses the resources it has available by relating the quantity of inputs to outputs. There is no disagreement on this general notion. However, the productivity literature and the use of various applications of productivity very quickly reveal that there is neither a unique purpose for nor a single measure of productivity.

There are many different ways of measuring productivity. The choice between each method depends on the purpose of the productivity measure as well as data availability. In essence productivity measures can be classified as single factor measures (relating a measure of output to a single measure of input) or total factor productivity measures (relating a measure of output to a combination of inputs[127]).

Table 44 illustrates the most frequently used productivity measures which are measures of labour and capital productivity, and total factor productivity measures (TFP[128]), based on a value added concept of output, or in the form of capital-labour-energy-materials (KLEMS[129]). TFP is based on a concept of gross output which corresponds to the Solow residual. The Solow residual is a measure of the change in total factor productivity in the Solow growth model. The Solow residual

[127] See Chapter two section 2.1.2 for a discussion of Solow residual.

[128] Total factor productivity (TFP) relates changes in output to several types of inputs. TFP is often measured residually, as that change in output that cannot be accounted for by the change in combined inputs. TFP addresses any effects in total output not caused by inputs. For example, a year with unusually good weather will tend to have higher output, because bad weather hinders agricultural output. A variable like weather does not directly relate to unit inputs or productivity, so weather is considered a total-factor productivity variable i.e. residual.

[129] The KLEMS (TFP) is a productivity measure that relates gross output to primary (capital and labour) and intermediate inputs (energy, other intermediate goods, services).

attributes to technology any change in output that cannot be explained by changes in factors output with regards to capital (K) labour (L) energy (E) and Materials (M). Among these measures value added based on labour productivity[130] is the single most frequently computed productivity statistic. (See OECD Productivity Manual, 2001b for an in-depth discussion of the various productivity measures)

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Table 44: Overview of main productivity measures

	Type of Measure			
Type of output measure:	***Labour***	***Capital***	***Capital & Labour***	***Capital, Labour & intermediate inputs (energy, materials, services***
Gross Output	Labour productivity (based on gross output)	Capital productivity (based on gross output)	Capital-Labour MFP (based on gross output)	KLEMS* total factor productivity
Value added	**Labour productivity (based on value added)**	Capital productivity (based on value added)	Capital-labour MFP (based on value added)	-
	Single factor productivity measures		Total factor productivity(TFP) measures	

* KLEMS = Capital, Labour, Energy, Materials

Source: OECD Productivity manual, 2001b, pp. 11

In order to establish the precise objectives for policy, the UK Government uses output per worker as the central measure for assessing the productivity gap. The shaded area in the table above depicts the type of productivity measure and the category which it falls within. Thus the productivity measure pursued by the Government is a single factor productivity measure which uses labour productivity, based on gross value added. The Government uses the output per worker measure of productivity for two reasons: the first being it is the most straightforward

130 One of the problems associated with using a single indicator like labour productivity is that it implies that all productivity gains are from labour.

to measure, therefore the least ambiguous, and secondly it can be immediately linked to the overall objective of raising the trend growth of productivity. However this measure only partially reflects total productivity, capturing the productivity of labour in terms of personal capabilities of workers or the intensity of their effort but does not capture the role of capital and technology.

The OECD Productivity Manual (2001b) reviews five of the most widely used productivity concepts. However as we are only concerned with labour productivity, based on gross value added concept we will discuss the major advantages and drawbacks of such a measure. One of the main advantages is ease of measurement and readability. The major limitation is that it is a partial productivity measure and reflects the joint influence of a host of factors. It is easily misinterpreted as the influence of technical change or as the productivity of the individuals in the labour force.

> *"Labour productivity is a useful measure as it relates to the most important factor of production and is intuitively appealing and relatively easy to measure. Also labour productivity is a key determinant of living standards, measured as per capita income and from this perspective is of significant policy relevance. However it only partially reflects the productivity of labour in terms of the personal capacities of workers or the intensity of their efforts. Labour productivity reflects how efficiently labour combined with other factors of production, how many of these inputs are available per worker and how rapidly embodied and disembodied technical change proceed."* OECD, 2001b pg 18

5.3 Data Sources

This section examines the data sources used to construct an original productivity data set which is used in the empirical research. Two specific UK national sources of data were used, the first being Office for National Statistics (ONS) and the second Annual Business Inquiry (ABI).

ONS was used to access employment data and ABI was used to access Output (GVA) data.

5.3.1 Office for National Statistics

The Office for National Statistics is the Government department that provides statistical and registration services. The Office was formed in April 1996 when the Central Statistical Office merged with the Office for Population, Censuses and Surveys.

The employment data[131] provided consists of three different data sets: Annual Business Inquiry (ABI), Annual Census of Employment (AES) and Census of Employment (CES). There exist various discontinuities[132] between these three data sets. For example, the ABI replaced the AES in 1998. The AES had a reporting date in September while the ABI has a reporting date of December. There are other differences between the AES and the ABI but the difference in the reporting date alone will mean that the two surveys produce different results and that it is dangerous to use the AES for 1997 alongside the ABI for 1998 without allowing for this. Despite these inadequacies it is the best employment data set available. A more comprehensive review of the differences between the AES and ABI are available on the ONS website[133]. The differences between the Census of Employment and the AES are less well documented. Most notably, the employment data covered Great Britain only and not the United Kingdom. In order to obtain data for the UK, Northern Ireland employment data was sought. The Northern Ireland Statistics and Research Agency (NISRA) were contacted and the same data was requested and added to the existing Great Britain employment dataset.

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[131] Absolute employment numbers were used.

[132] The discontinuities are known differences for example in the methodology, coverage, timing or processing which give rise to different estimates.

[133] http://www.statistics.gov.uk/downloads/theme_labour/ABI_QandA.pdf

5.3.2 Annual Business Inquiry (ABI)

In 1996, the ONS began work on a project to integrate a range of its annual inquiries into a single system known as the Annual Business Inquiry (ABI). The objective of the project was the desire for greater consistency and simplicity which could be achieved by replacing a wide range of inquiries by a single integrated system.

The ABI was developed in the mid-1990s, when reorganisation in the Government led to some of the statistical functions from the former Employment Department (ED) being transferred to the then Central Statistical Office (CSO). This led to some duplication between the ex-CSO and the ex-ED surveys. The CSO (which shortly thereafter became the Office of National Statistics) embarked on a programme to rationalise first its monthly and quarterly surveys and later its annual surveys. The rationale for the initiation of the ABI was primarily to remove duplication between existing surveys. The development of ABI activities is underlined by four key aspects. The first being that surveys would be for the whole economy, since previously data collected for business surveys were only sourced from some sectors of the economy. Secondly it would collect both employment and financial information from the same sample of businesses, which would lead to greater consistency between the estimates for employment and economic variables. Thirdly, the new combined survey would allow ONS to manage the form filling burden in a more structured way. Finally the new Survey would meet the requirements of the new EC Regulation on Structural Business Statistics which formalised the UK's obligation for generating and supplying employment and economic data.

The AES was already providing employee data on jobs that met the needs of its users. However, the methods used to conduct AES were quite different from those used to conduct the annual financial inquiries, which meant that it was not as feasible to compare employment and economic data, as combining the results from the two surveys led to inconsistencies between the two data sets. The introduction of ABI is essentially to improve consistency between the various ONS datasets, thus enabling ONS to introduce more robust short-term estimates of productivity growth than had been possible in the past.

The sample for ABI is drawn from the inter-departmental business register (IDBR). The sample size in 1998 was approximately 78,500. The inquiry results are grossed up to the population of the IDBR using the combined ratio estimator[134] to register the population, so that they can relate to the businesses on the IDBR for the sectors covered. The sample design is a stratified random one with three stratification dimensions:

- Six employment size bands (1-9, 10-19, 20-49, 50-99, 100-249, 250+)
- Region (Viz: England Wales combined/Scotland/ Northern Ireland)
- Standard Industrial Classification (SIC) Industry[135].

While ABI is itself a sample, it is widely (but not universally) accepted as an accurate approximation to the total. The introduction of the ABI brings a new set of procedures for generating estimates of employee jobs

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[134] A combined ratio estimator is similar to the standard ratio estimator except the strata correspond to different sidebands. For example factors were produced to enable estimates for all businesses classified to each SIC(92)/ SIC(2003) to be compiled from data provided by responding businesses. These factors were calculated for each employment size-band within each SIC(92)/ SIC(2003) and are equivalent to the ratio of responding businesses to the total number of businesses. Northern Ireland and Scotland are sampled and estimated for separately, England and Wales are sampled separately but are combined for the estimation procedure.

[135] A *Standard Industrial Classification* (SIC) was first introduced into the United Kingdom in 1948 for use in classifying Business establishments and other statistical units by type of economic activity in which they are engaged. The classification provides a framework for the collection, tabulation, presentation and analysis of data and promotes uniformity. Since 1948 the classification has been revised in 1958, 1968, 1980, 1992 and 1997. Revision is necessary because over a period of time new products and industries emerge and shifts of emphasis occur in existing industries.

by industry and geography. Of particular interest to this thesis is the output (GVA) measure. Regional Gross Value added by industrial activity for the period 1989- 2000 is freely available to the public to download from the ONS website[136]. However, it is important to note that the data are based on current prices and not constant prices, therefore inflation is not accounted for. This is discussed in section 5.3.5.

5.3.3 Mapping Data

Once the two data sets were acquired it was important to amalgamate them, according to identical groupings to enable Output/GVA per worker to be calculated. The publicly available GVA data are classified according to industry **section** and **subsection,** whereas the employment data provided by ONS is classified according to 2 digit SIC **division** (ESA95 sectoral definitions). The SIC classification uses a top-down hierarchical five digit system. At the first level UK SIC (92) is divided into 17 sections, each denoted by a single letter from A to Q. Some sections are in turn divided into subsections (each denoted by the addition of a second letter). The letters of the section or subsections can be uniquely defined by the next breakdown, the divisions (denoted by two digits). For example:

Section D	Manufacturing (comprising divisions 15 to 37)
Subsection DB	Manufacture of textiles and textile products (comprising divisions 17 and 18)
Division 17	Manufacture of textiles
Group 17.4	Manufacture of made-up textile articles, except apparel
Class 17.40	Manufacture of made-up textile articles, except apparel
Subclass 17.40/1	Manufacture of soft furnishings

136 www.statistics.gov.uk/StatBase/Product.asp?vlnk=7359&Pos=2&ColRank=2&Rank=272

There are 17 sections, 16 subsections, 60 divisions, 222 groups, 503 classes and 253 subclasses. Appendix 10 provides a table which depicts the data mapping exercise which amalgamates the two data sources[137]. Output per worker was therefore calculated at the section and subsection level. The section and subsection level data forms the basis of the empirical analysis which is divided into two distinct categories which form the basis of the sub hypotheses; the first category represents manufacturing sub sectors (subsection level data); the second category represents the sectors which make the total economy and therefore include manufacturing (section level data).

5.3.4 Time series data

In order to calculate output per worker, it was essential that the data for the employment and the output years mapped onto each other. The GVA data are available from 1989 onwards. However, when considering the employment data, due to the reclassification of SIC data in 1992, it was decided that data would only used for the period 1991 onwards. The main reason for this choice is primarily time constraints. It would have been both time consuming and costly to reclassify the employment data prior to 1992, according to the new 1992 reclassification. It is also important to note that prior to 1995 the ONS survey was bi-annual, hence there is no employment data for 1992 and 1994. Despite these discouraging aspects of the data, a quality original dataset was developed (see Appendix 11 for a specimen of the data set compiled for the North East and for the UK regions)

[137] A top-down approach was used to identify divisions which makeup section and sub section GVA level data. With regards to the employment data a bottom-up approach was used so as division level data summed to section and sub section level.

5.3.5 Accounting for Inflation

As noted earlier, the publicly available GVA data from ONS are in current prices[138], which need to be converted into constant price[139] series for comparative purposes (i.e. to remove the effect of inflation as output has been overestimated). Therefore deflation of the GVA shows real output, allowing for adjustments in the monetary value. The next stage was to convert the current prices data by the appropriate deflator. Deflators were yet again publicly available to download from the ONS website[140]. The deflator[141] titled *'Gross Value added at basic prices'* was used as displayed in Table 45 and thereafter the basic prices GVA data was converted into constant prices.

Table 45: Gross Value added at basic prices - Price Index: 1995 = 100

Year	Price Index	Deflator
1989	79.9	1/79.9
1991	90.7	1/90.7
1993	96.8	1/96.8
1995	100	100
1996	103.4	1/103.4
1997	106.2	1/106.2
1998	108.8	1/108.8
1999	111.2	1/111.2
2000	113.6	1/113.6

Adapted: ONS, natpa 1

138 Current prices are the actual or estimated recorded monetary value over a defined period for a group of industries or products. They show the value for each item expressed in terms of the prices of that period.

139 Constant prices refer to volume measures whose values are derived prices by applying to current quantities, prices pertaining to a specific base period. They allow figures to be represented so that the effects of inflation are removed. The values for each time period are expressed in terms of the prices in some base period (e.g. National Accounts currently show constant price data at 1995 prices.).

140 www.statistics.gov.uk/StatBase/tsdataset.asp?vlnk=204&Pos=1&ColRank=2&Rank=256

141 The deflator is an index showing the price movements over a period of time. Constant price data are normally calculated by dividing current price data by the deflator. If constant prices are worked out other than by this deflation procedure, one may calculate an implicit deflator as current prices divided by constant prices data.

One of the major problems with using national price deflators is that there are no regional price deflators. Constant prices series are useful for comparing individual series over time, but less so for comparisons across regions; this is discussed in depth in section 4.4 (see Appendix 11 for a specimen of the data set compiled for the North East and for the UK regions.

5.3.6 Calculating Productivity

Once the data had been compiled into an appropriate spreadsheet, output per worker was calculated, which as noted earlier is one of the most popular measures of productivity used as well as the central measure the Government relies on to assess the productivity gap. Appendix 11 provides a specimen of the data set compiled for the North East region.

5.4 Data Quality

The regional GVA output data suffers from several inadequacies which will inevitably have implications for the results obtained based on this data set. In an HM Treasury press notice on 27th February 2003, the Chancellor of the Exchequer asked Christopher Allsopp to undertake a wide-ranging review of the informational and statistical requirements for monetary and wider economic policy making. One of the terms of reference for the review was to deliver an assessment on:

> *"the regional information and statistical framework needed to support the Government's key objective of promoting economic growth in all regions and reducing persistent gap in growth rates between the regions"*

The first Allsopp Report (2003) noted that present estimates of regional Gross Value Added (GVA) are not of sufficient quality to support analysis of the Government's policy objective to increase growth in the regions. The first report concentrated on the informational requirements for regional economic policy. The final Allsopp Report (2004) addressed to the Chancellor of the Exchequer, the Governor of the Bank of England and the National Statistician focussed mainly on the question of whether the changing economic structure of the UK is being properly reflected in the nature and frequency and timeliness of official economic statistics. The principal outcome noted was the recommendation that the development of better quality GVA estimates should be a high priority and that good quality baseline GVA estimates for NUTS[142] one regions and improved detail at lower levels were required as part of an integrated system producing both national and regional accounts. The general inadequacies of the data are listed bellow.

- ***Regional Price deflators***

  In the absence of regional price deflators, national price deflators are used. Hence if rates of price inflation differ regionally from the UK average inevitably the volume of GVA will be over-or under estimated, according to whether territorial inflation is above or below national average implying measurement error.

- ***Financial Intermediation Services Indirectly Measured (FISIM)***

  FISIM[143] represents income of the financial sector resulting from differences in interest rates rather than payment for a service. FISIM has been excluded from the compiled data set because it does not score against the territorial distribution of GVA.

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[142] Nomenclature des Unités Territoriales Statistiques

[143] FISIM is the part of the service charges received by financial intermediaries which is indistinguishably included with the interest charged on loans and the interest paid on deposits. In theory to construct the sector accounts this service charge should be allocated across sectors and regions using these services but this cannot actually be done directly since payees do not know what part of their interest covers the service charge. Therefore in the past the whole of this service charge has been allocated to a nominal sector.

- ***Residence versus Workplace***

  GVA data at the regional level are available according to both workplace and the place of residence of income receivers. Estimates of GVA by industry groups at current prices by region are on a *Residence* basis whereas the income of commuters is allocated to where they live as opposed to their place of work (*Workplace*). Therefore the residence based GVA does not capture cross border commuting. According to Cockerill (2004a) comparisons of the two indicates the significance of inter-regional commuting on measured GVA. Cockerill (2004a) finds the effect to be significant only for London, the South East and the East of England regions.

5.5 Data set

The data set is briefly introduced where Table 46 and Table 48 show indices of output per worker by sector for the twelve regions of the UK, relative to the UK average for the period 1991 and 2000. The shaded areas represent sectors which show regional output per worker that is above the UK average. Prior to the discussion of the compiled data set it is important to note sector weightings are not explored in this section.

In 1991 the North East, North West, East of England, London, South West and Wales showed above UK average output per worker indices for total manufacturing (Table 46). The remaining six regions show below UK average output per worker. London and Scotland have nine manufacturing sub sectors with above UK average output per worker in 1991 as opposed to the West Midlands which only had two sectors. Sector 20 (*Wood & wood products*) and 26 (*Non-metallic mineral products)* are the two manufacturing sub sectors where eight regions show above UK average output per worker. On the contrary sectors 19 (*Leather*) and 21-22 (*Paper, printing & publishing*) have only four regions with above UK average output per worker. The bottom half of Table 46 reports on the output per worker indices for 2000. Only four regions (London, South East, South West & Scotland) show above UK average output per worker indices for total manufacturing in 2000 as opposed to six in 1999. Eight regions had above UK average output per worker in 1991 and 2000 for Sector 26 (*Non-metallic mineral products).*

Upon comparison of the 1991 and 2000 indices for total manufacturing the North East, East of England and the North West have become less productive over time relative to the UK which suggests divergence. In contrast, London, South East and South West have become even more productive. In addition the North East, North West, Yorkshire and Humber and the West Midlands have become less productive in various manufacturing sub sectors over time relative to the UK. Table 47 compares the number of regions within the manufacturing sector which showed above UK average indices in 1991 & 2000.

Table 46: Indices of output per worker, relative to the UK by region, 1991 & 2000 (Manufacturing Sub Sectors)

1991

MSS		UK	NE	NW	YH	EM	WM	E	L	SE	SW	W	S	NI
17-18	Textile & clothing	100	98.27	104.57	111.85	95.68	87.43	95.4	110.7	108.27	91.78	87.45	106.19	81.43
19	Leather	100	0	93.79	142.92	86.08	94.31	99.19	179.72	88.18	91.33	0	225.73	100.88
20	Wood & wood products	100	89.09	79.17	116.16	96.77	100.72	28.23	123.84	138.35	107.69	122.85	116.47	117.09
21-22	Paper printing & publishing	100	93.34	100.64	85.53	85.56	85.12	98.26	121.92	96.15	94.12	100.63	103.08	91.42
24	Chemical & man made fibres	100	86.36	109.65	105.1	96.83	69.09	90.82	98.87	125.57	71.37	106.92	88.54	107.49
25	Rubber & plastic products	100	142.61	91.12	84.47	101.07	91.14	112.92	110.82	105.99	98.95	101.76	119.2	71.87
26	Non-metallic mineral products	100	100.68	113.59	105.68	99.16	74.84	95.44	99.22	111.31	150.08	124.2	102.93	103.69
27-28	Basic metals	100	92.49	76.57	101.63	100.07	104.87	106.88	99.77	93.62	88.18	155.44	80.33	80.89
29	Other metals	100	146.08	92.47	111.29	101.68	88.05	89.35	128.12	100.67	94.87	71.32	115.38	70.07
30-33	Electronic & optical	100	112.77	97	84.09	89.18	98.45	99.82	118.88	102.73	92.24	106.19	108.17	69.22
34-35	Transport equipment	100	87.36	128.37	100.44	110.45	92.98	111.56	114.27	84.97	87.68	121.93	78.43	82.05
36-37	Other manufacturing	100	95.48	83.05	92.04	81.29	70.45	156.93	204.79	43.77	170.7	84.46	114.76	103.65
15-37	Total manufacturing	100	104.52	103.4	94.74	88.76	87.86	104.48	125.77	106.97	96.41	113.6	98.56	77.35

2000

MSS		UK	NE	NW	YH	EM	WM	E	L	SE	SW	W	S	NI
17-18	Textile & clothing	100	95	90.58	100.96	90.46	95.79	126.44	129.06	146.38	117.8	101.21	101.72	76.22
19	Leather	100	0	0	115.09	88.71	75.91	107.39	105.38	164.61	140.98	81.41	118.21	62.06
20	Wood & wood products	100	102.73	89.3	86.8	89.55	91.05	107.42	138.67	121.05	102.4	99.65	109.17	84.17
21-22	Paper printing & publishing	100	94.47	82.24	82.55	78.62	78.49	96.82	126.84	106.73	90.93	85.59	94.86	87.29
24	Chemical & man made fibres	100	102.78	100.82	74.82	80.7	71.26	86.25	122.18	126.51	77.69	120.38	97.57	103.13
25	Rubber & plastic products	100	93.68	98	99.38	97.38	100.21	94.37	93.59	101.2	100.41	105.92	110.28	82.92
26	Non-metallic mineral products	100	94.47	111.44	105.54	100.69	75.3	103.18	109.42	123.85	90.63	127.6	103.28	77.12
27-28	Basic metals	100	92.49	93.47	105.11	96.9	84.92	93.5	107.21	104.33	91.77	118.6	113.51	91.7
29	Other metals	100	104.26	89.77	93.48	94.49	96.03	102.39	124.69	109.9	106.04	91.05	92.29	82.14
30-33	Electronic & optical	100	79.04	97.27	91.89	82.63	95.09	93.68	112.98	105.07	106.04	85.06	108.07	89.51
34-35	Transport equipment	100	111.48	106.56	92.97	132.67	92.45	92.47	105.15	94.01	100.22	100.11	102.74	88.06
36-37	Other manufacturing	100	83.51	87.77	103.36	87.09	93.02	116.49	161.11	68.85	142.35	86.96	103.11	90.06
15-37	Total manufacturing	100	97.17	81.84	89.95	88.14	84.11	98.67	130.24	114.29	101.22	99.26	104.75	80.94

Note: Constant Prices

Source: Author's calculations

Table 47: Comparisons of the number of regions which show above UK average Output per worker indices (Manufacturing sub sectors)

MSS		1991	2000
17-18	Textile & clothing	5	7
19	Leather	4	6
20	Wood & wood products	8	6
21-22	Paper printing & publishing	4	2
24	Chemical & man made fibres	5	6
25	Rubber & plastic products	7	5
26	Non-metallic mineral products	8	8
27-28	Basic metals	5	5
29	Other metals	6	5
30-33	Electronic & optical	5	4
34-35	Transport equipment	6	7
36-37	Other manufacturing	5	4
15-37	Total manufacturing	6	4

Source: Table 46

Table 47 shows that over time relative to the UK average the number of regions in four[144] sectors have become more productive over time relative to the UK average as opposed to seven[145] sectors (including total manufacturing) where the contrary is apparent. Sectors 26 (*Non-metallic mineral products)* and 27-28 (*Basic metals*) showed no changed in the number of regions that reported above UK average indices. It must be borne in mind that regions are not distinguished between, the emphasis is on sectors.

Table 48 compares the indices for the total economy. Only three regions (East of England, London and South East) showed output per worker levels above the UK average in 1991. Of the twelve sectors which makeup the total economy eleven sectors in the East of England showed above UK average output per worker indices, closely followed by ten sectors in London and the South East, as opposed to only two sectors in Yorkshire and Humber in 1991.

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[144] 17-18 (Textile & clothing), 19 (Leather), 24 (Chemical & man made fibres), 34-37 (Transport equipment)
[145] 20 (Wood & wood products), 21-22 (Paper printing & publishing), 25 (Rubber & plastic products), 29 (Other metals), 30-33 (Electronic & optical), 36-37 (Other manufacturing), 15-37 (Total manufacturing)

Table 48: Indices of output per worker, relative to the UK by region, 1991 & 2000 (Total Economy)

1991

TE		UK	NE	NW	YH	EM	WM	E	L	SE	SW	W	S	NI
01-02	Agriculture, hunting & forestry	100	90.76	107.76	103.34	107.25	106.47	104.84	113.17	74.28	94.93	83.06	139.99	108.04
15-37	Manufacturing	100	104.52	103.4	94.74	88.76	87.86	104.48	125.77	106.97	96.41	113.6	98.56	77.35
40-41	Electricity, gas and water supply	100	109.51	99.66	89.89	89.94	98.82	100	119.57	96.04	92.72	113.41	108.97	90.29
45	Construction	100	75.9	86.72	84.47	105.78	86.63	149.63	106.76	130.25	129.17	90.04	73.26	72.24
50-52	Wholesale & retail trade	100	91.47	93.35	93.86	99.82	95.62	107.52	117.62	106.01	93	88.59	93.18	88.85
55	Hotels & restaurants	100	82.42	112.14	85.89	97.46	92.55	102.25	138.06	104.76	88.52	85.29	96.22	105.9
60-64	Transport, storage and communications	100	100.03	94.53	95.99	94.52	90.76	116.17	98.01	115.62	91.49	88.39	98.6	83.88
65-67	Financial intermediation	100	96.61	83.97	83.92	92.8	86.33	155.04	101.5	110.15	78.9	89.93	94.91	69.08
70-74	Real estate, renting and business activities	100	88.71	87.9	93.6	104.54	93.4	115.54	95.44	115.25	106.06	107	90.22	97.96
75	Public administration & defence	100	76.38	71.13	102.38	99.19	84.47	128.15	76.7	138.52	127.15	78.79	103.99	130.41
80	Education	100	97.85	101.73	94.06	77.77	95.22	92.28	124.99	90.65	92.76	106.63	120.27	85.18
85	Health & social work	100	98.7	92.54	91.33	94.11	95.37	106.76	109.14	107.84	93.56	101.15	103.84	99.06
90-93	Private households with employed persons	100	78.23	82.25	85.17	96.08	87.14	122.53	120.26	117	92.36	89	91.54	66.7
Total	Total Economy	100	92.14	93.07	92.12	95.28	91.47	116.41	106.13	112.66	97.75	95.7	96.33	87.57

2000

TE		UK	NE	NW	YH	EM	WM	E	L	SE	SW	W	S	NI
01-02	Agriculture, hunting & forestry	100	100.39	121.78	125.73	108.25	119.8	100.94	22.18	67.22	124.27	114.88	86.04	76.79
15-37	Manufacturing	100	97.17	81.84	89.95	88.14	84.11	98.67	130.24	114.29	101.22	99.26	104.75	80.94
40-41	Electricity, gas and water supply	100	86.67	98.05	110.92	87.04	79.88	87.08	129.56	114.53	106.29	90.54	125.07	90.45
45	Construction	100	71.3	86.22	95.23	105.57	101.83	134.07	105.71	117.09	103.17	77.81	80.75	95.98
50-52	Wholesale & retail trade	100	82.1	96.33	93.42	103.16	94.92	103.54	113.12	108.78	85.67	87.53	93.7	96.32
55	Hotels & restaurants	100	84.79	86.2	84.84	87.65	103.87	98.1	121.45	93.36	88.07	107.11	91.71	88.1
60-64	Transport, storage and communications	100	90.6	92.56	88.58	88.98	84.57	112.16	104.84	118.32	88.67	89.02	96.35	91.35
65-67	Financial intermediation	100	98.53	86.66	85.01	101.1	86.58	146.77	99.01	114.42	82.69	80.27	81.2	89.78
70-74	Real estate, renting and business activities	100	93.79	94	83.25	92.47	94.43	111.48	91.17	113.55	108.37	107.31	84.04	107.69
75	Public administration & defence	100	75.64	78.5	104.11	97.72	87.04	151.92	74.37	147.05	123.29	81.65	114.16	117.59
80	Education	100	98.2	102.07	88.15	101.94	90.75	103.31	116.45	87.86	87.44	103.03	98.7	84.67
85	Health & social work	100	93.74	97.95	97.06	91.65	94.72	98.52	107.53	105.98	92.12	99.45	92.63	82.25
90-93	Private households with employed persons	100	70.1	89.09	77.83	79.78	79.52	107.96	127.43	103.11	88.21	89.99	89.06	163.52
Total	Total Economy	100	88.06	90.67	91.28	97.65	92.15	115.91	104.5	114.49	94.97	93.09	94.43	92.16

Note: Constant Prices

Source: Author's calculations

Upon comparison of the output per worker indices for the total economy[146] in 1991 and 2000 (Table 48) it becomes apparent simply by comparing the shaded areas that more sectors within the various regions have increased their productivity over time relative to the UK. In 1991 and 2000 the three same regions (East of England, London & South East) showed above UK average output per worker indices. The North East had three sectors with above UK average productivity in 1991, but only one sector (*Agriculture, hunting & forestry*) in 2000. The West Midlands had only one sector (*Agriculture, hunting & forestry*) with above UK average productivity in 1991 to having three sectors (01+02, *Agriculture, hunting & forestry;* 45, *Construction;* 75, *Public administration & defence*) in 2000. The South East region was the only region that sustained the same number of sectors with above UK average productivity for the two periods.

Following the analysis in Table 47 we compare in Table 49 below the relative change in output per worker indices for the sectors which makeup the total economy. Table 49 shows that overtime relative to the UK average the number of regions in two[147] sectors have become more productive over time relative to the UK average as opposed to two[148] sectors. Nine sectors[149] showed no change in the number of regions that reported above UK average indices which also included the total economy. Yet again it must be borne in mind that regions are not distinguished between; the emphasis is on sectors.

[146] The total economy includes manufacturing
[147] 45 (Construction) and 50-52 (Wholesale & retail trade)
[148] 15-37 (Manufacturing) and 55 (Hotels & restaurants)
[149] 01-02 (Agriculture, hunting & forestry), 40-41 (Electricity, gas and water supply), 60-64 (Transport, storage and communications), 65-67 (Financial intermediation), 70-74 (Real estate, renting and business activities), 75 (Public administration & defence), 80 (Education), 85 (Health and social work), 90-93 (Private households with employed persons) and the Total Economy

Table 49: Comparisons of the number of regions which show above UK average indices (Total Economy)

TE		1991	2000
01-02	Agriculture, hunting & forestry	8	8
15-37	Manufacturing	6	4
40-41	Electricity, gas and water supply	5	5
45	Construction	5	6
50-52	Wholesale & retail trade	3	4
55	Hotels & restaurants	5	3
60-64	Transport, storage and communications	3	3
65-67	Financial intermediation	3	3
70-74	Real estate, renting and business activities	5	5
75	Public administration & defence	6	6
80	Education	5	5
85	Health & social work	2	2
90-93	Private households with employed persons	4	4
	Total Economy	**3**	3

Source: Table 48

The output per worker indices in Table 46 and Table 48 for the North East show that the labour productivity gaps are widening relative to the UK average. Chapter three set out five key drivers that underlie productivity and how the performance against each of the drivers helps explain the variation in regional productivity levels.

5.6 Methodology

The methodology is essentially a quantitative one, which encompasses various methods, supported by well established statistical techniques. The empirical investigation is rooted in the initial proposition, in the application of a simple statistical technique known as shift share analysis. It is applied to regional employment change and a modified version of the technique is then applied to measure changes in inter-regional inequality in output per worker. Thereafter the validation of the initial proposition can be broken down into two distinct groups of methods; the first commonly referred to as non-parametric statistics (Spearman rank correlation coefficient and Kendall coefficient of concordance) and the second group of methods commonly referred to as measures of inequality (The coefficient of variation, Theil coefficient, and Gini coefficient) enabling the assessment of convergence and divergence trends.

The assessment of convergence/divergence trends typically involves the use of one or more indexes that measures the dispersion or degree of the inequality variable which in the context of this thesis refers to output per worker. Since Williamson's (1965)[150] seminal work on national development and regional inequality, the coefficient of variation has become one of the major indices of dispersion used in regional analysis. The coefficient of variation is the most basic statistical measure available and the most frequently used to measure inequality. Theil and Gini coefficient are a further two standard inequality measures applied to assess the degree of inequality in the regional context.

These methods are discussed individually in the following sections, in which they are further critiqued and reasons for their application to this thesis are justified, supported by principal and sub hypotheses.

5.7 Shift Share analysis

As noted earlier in Chapter four, manufacturing is a prominent feature of the North East economy. Therefore the economic structure of the North East is modelled against the UK in order to understand the importance of manufacturing in terms of employment and output per worker at the national and regional level. Hence in the first instance the extent to

[150] Williamson (1965) argued that catching up regions experiencing strong national growth tend to see a widening of regional disparity, whereas in more developed economies strong national growth and failing disparities go hand in hand. He supported the idea of a non linear relationship between national development and regional disparities, a view supported by geography and development economists.

which differences in the share of employment between the region and nation are explained by a region's industry mix is explored and in the second instance the role of the industry mix in explaining regional inequality in output per worker is examined. The most useful approach which addresses these two hypotheses is by means of shift share analysis. Shift share analysis is a popular and simple technique that has been used in regional analysis since 1940. Shift Share analysis is a technique for analysing regional disparities in employment, most applications have been directed towards regions with employment problems.

Hence the first two hypotheses seek to investigate the regional and national growth differences in relation to the industry mix. The following null hypotheses are to be tested:

> *H1: The North East's industry mix does not explain the difference between national and regional employment change.*
>
> > *H1a: Manufacturing sub sectors*
> >
> > *H1b: Total Economy*

H1 will provide a snapshot of the difference between national and regional employment growth. This is aggregate growth between the two years 1991 and 2000 and not the annual rate.

> *H2: The North East's industry mix does not explain the difference between national and regional output per worker.*
>
> > *H2a: Manufacturing sub sectors*
> >
> > *H2b: Total Economy*

H2 is cross sectional analysis which considers each individual year from 1991 to 2000.

The primary aim of testing these two hypotheses is firstly to compare the movements in employment[151] and output per worker of the North East economy in relation to the UK as a whole. Secondly it is to consider the difference between sectors which make up the total economy and the manufacturing sub sectors. Hence these two principal hypotheses are further broken down into two sub-hypotheses one which focuses primarily on manufacturing sub sectors, and the second which considers the sectors which make up the total economy (which includes manufacturing). The final aim is to consider the extent to which these differences are attributed to the economic structure of the region. In addition shift share is applied to the eleven remaining regions of the UK so as to depict cross regional differences.

Principles of Shift Share

The relationship between industrial structure and regional economic growth is often analysed and broken down into various effects by means of shift-share analysis. Shift share analysis is a method to provide calculations of regional economic activity with a minimum of available data. Shift share analysis was originally proposed by Dunn (1960) as a forecasting technique for regional growth (usually, employment). The essential idea is to analyse the extent to which the difference in employment change between each region and the national average is due to the region performing uniformly better than average on all industries or to the fact that the region happens to be specialised in fast growing sectors (recent applications include Garcia-Milà & McGuire, 1993).

[151] Chapter three noted that productivity growth is one of the most important sources of economic expansion and hence it is a key source of the rise in output and income. There is another important aspect of productivity; its impact on employment change. Although productivity growth plays a crucial role in economic growth in the long run by attracting new business and therefore creating new jobs, it may have a negative impact on sector-specific employment change in the short run, because it will be possible to produce the same amount of output with less labour. In that sense understanding productivity, measuring and explaining productivity growth and its impact on the regional economy are very important and are a major concern for policy makers and in the promotion of sound economic development policies and programs.

Esteban (1972) modified the standard two-factor[152] decomposition and extended it to the sum of three components: structural, differential and allocative. The structural component indicates the growth share attributable to the particular industry mix of each specific region. The differential component measures the part of growth due to region specific factors. Finally, the allocative component measures the covariance between the two previous components. This can be interpreted as the contribution to regional growth deriving from its specialisation in those activities where the region is most competitive.

5.7.1 Algebraic formula for calculating employment growth

This analysis facilitates the examination of regional growth by portioning it into three components. The shift share essentially uses three components[153] to explain the disparity between regional and national growth. The method of calculating the three components of a region's employment[154] growth is easily explained:

1) Regional Growth Rate (g_r)

$$g_r = \frac{\sum_i e_i^t - \sum_i e_i^0}{\sum_i e_i^0} \times 100$$

[152] Initially it was used to decompose growth differentials between a regional and national average into two components: The growth differential due to better/worse than national average performance of the region; the growth differential due to the specialisation of the region in fast/growing sectors.

[153] The terminology used in shift share literature is some what diverse. The national growth effect is also referred to as the share effect or total share, the proportional shift is also termed the industry mix effect or the compositional effect and the differential shift is also called the regional effect or competitive position effect.

[154] Any aggregate indicator can be used in the context of this thesis employment and output, are considered in this section.

Where:

e_i = regional employment in industry i

$\sum e_i$ = sum of employment in all industries in the region

t = final year of study

0 = initial year of study

2) National Growth Rate (g_n)

$$g_r = \frac{\sum_i E_i^t - \sum_i E_i^0}{\sum_i E_i^0}$$

Where:

E_i = national employment in industry i

$\sum E_i$ = sum of employment in all industries in the nation

3) Regional growth at national growth rates per industry (g_{rn})

$$g_{rn} = \frac{\sum_i \left[e_i^0 \left(E_i^t / E_i^0\right)\right] - \sum_i e_i^0}{\sum_i e_i^0} \times 100$$

This calculation is the positive or negative growth that *would* have occurred in the region if each industry had grown at the same rate as the corresponding national industry during the period of study. Hence the national growth rates are applied to the region's industry mix as it existed at the beginning of the study period.

These three definitions can now be used to show that a region's employment growth can be divided into three separate components.

Region's employment growth	Growth to due to other factors	Growth due to industry mix	National growth
g_r	$(g_r - g_{rn})$	$(g_{rn} - g_n)$	g_n
Components of the shift share identity	Residual component	Structural Component	National Component
	Part of a regions growth that remain unexplained	The difference between; National growth rate and the rate which we expect the region to grow given its industry mix and given national growth rates for each industry	The faster the national growth the faster the region can be expected to grow

Adapted: Armstrong & Taylor (2000)

When considering the elements in reverse order, the national growth rate component g_n measures the region's share of national growth. It measures the expected growth, in any aggregate indicator if the region had grown at the national rate over the period.

The proportional shift $(g_{rn} - g_n)$ represents the amount of change the regional would have experienced had each of its industries grown at their national rates. If a region has a predominance of industries which are growing faster than the national economy, then the region will register a positive proportional shift component. In contrast, if a region has an unfavourable industry mix this will register a negative proportional shift.

The differential shift $(g_r - g_{rm})$ is generally calculated as a residual. It reflects differences between the region's industrial growth rates and their national counterparts, and is conventionally interpreted as that part of the regional growth performance which is attributable to regional specific factors and comparative advantage (Holden *et al.*, 1989). In essence the differential shift component is that part of the region's growth that remain unexplained, this can include all kinds of factors such as: entrepreneurial ability; effects of regional policy; and regional local advantages and disadvantages.

5.7.2 Algebraic formula for calculating inter-regional aggregate productivity differentials

Even though the *shift share* technique analysis was originally conceived as a technique to analyse regional employment dynamics, it is straight forward to modify and extend it to the decomposition of inter-regional aggregate productivity differentials. Aggregate output per worker is the output weighted sum of the productivities at the sectoral level. Thus, a particular region can have an aggregate output per worker above the national mean because of two reasons (or a combination of both). On the one hand, it can be that in all, or most, a sector in this region has output per worker above the mean. On the other hand it can be that sectoral productivities are not different from the mean, but that this region is specialised in those sectors with higher output per worker. For instance, the average productivity in agriculture, in industry or in the service sector could be identical in each sector across the UK regions. Yet, the regions specialised in services would have an aggregate output per worker higher than those specialised in agriculture. The method of calculating the three components of regional deviation in productivity is easily explained.

The *industry mix* component μ_i of region i measures the differential productivity accruing from region i's specific sectoral composition, once we assume that sectoral productivities in each region are equal to the UK averages[155]. Hence we write;

$$\mu_i = \sum_j \left(p_i^j - p^j\right)x^j$$

p_i^j = sectors j's employment share in region i, hence $\sum_{j=1} p_i^j = 1$

p^j = sectors j's employment share nationally, hence $\sum_{j=1} p^j = 1$

x_i^j = output per worker per in sector j and region i, hence $\sum_{j=1} p_i^j x_i^j = x_i$

(regions i's output per worker) $\sum_{j=1} p_i^j = 1$

x^j = sectors j's productivity, hence $\sum_{j=1} p^j x^j = x$ (national output per worker)

μ_i takes on positive values if the region is specialised $\left(p_i^j > p_i\right)$ in sectors with high productivity at the UK level and de-specialised $\left(p_i^j > p_i\right)$ in sectors of low productivity. μ_i is at a maximum if the region is specialised in the most productive sector UK wide. Conversely, μ_i is at a minimum if the region is specialized in the least productive sector.

The *Productivity differential* component π_i focuses on the contribution of sectoral productivity differences to the shift between the regional and national average productivities, on the assumption that the region's industry mix coincides with national one[156]. Hence we define π_i as:

$$\pi_i = \sum_j p^j \left(x_i^j - x^j\right)$$

155 The industry mix can be rewritten as: $\sum_j p_i^j x^j = x + \mu_i$

156 The productivity differential component can be rewritten as: $\sum_j p^j x_i^j = x + \pi_i$

π_i takes on positive values if the region has sectoral productivities above the UK national average. Furthermore, for a given sectoral productivity differential, π_i is increasing in the share of this sector at the national level.

The *allocative* component α_i is a combination of the two previous components and is defined as

$$\alpha_i = \sum_j \left(p_i^j - p^j\right)\left(x_i^j - x^j\right)$$

The allocative component can is viewed as measuring the covariance between sectoral specialisation and productivity advantages hence is the covariance of the two effects (Industry mix and the Productivity differential). This component is positive if the region is specialised, relative to the UK average, in sectors, whose productivity is above the UK average, and negative if below it. This component is also an indicator of the efficiency of each region in allocating resources over different industrial sectors. The three components are then brought together

$$x_i - x = \mu_i + \pi_i + \alpha_i$$

In the formula above we have the gap between regional and national average productivities additively decomposed into the three components, where each component aggregates one source of regional differential productivity.

5.7.3 Shift Share and Analysis of Variance

The analysis of variance has become more widely used after a pioneering application of Weeden (1974) whose work formed the basis of sections of the earlier study by Brown (1972). Analysis of variance is a well established statistical technique with a large literature to underpin it, unlike shift share. Variance analysis is applied so as to measure the role played by each shift share component in explaining inter-regional differences in "output per worker" whereby the relative weight of the variance of each component in the overall observed variance is computed, together with a term collecting co-variances. The formula applied is;

$$\mathrm{var}(y) = \mathrm{var}(\mu) + \mathrm{var}(\pi) + \mathrm{var}(\alpha) + 2\left[\mathrm{cov}(\mu,\pi) + \mathrm{cov}(\pi,\alpha)\right]$$

The ability to assess the statistical significance of the components gives analysis of variance an advantage which is more apparent than real. That is, it highlights variance that is probably real, but the possibility remains that it is not a non-random effect. One of the important advantages usually cited for the analysis of variance in comparison with shift share is that estimates are provided for the variance of its components. This enables parametric tests to be performed to assess the statistical significance of the components, the important point being that it is possible to identify whether a region has a statistically significant regional element in its growth.

5.7.4 The industry mix

Shift share analysis is a popular technique for analysing regional disparities between the regional and national growth rates. Hence shift share analysis is a method of calculating the extent to which the difference between a region's growth and the nation's growth can be accounted for by a region's industry mix. There are several reasons why industrial mix may influence how an economy grows. Garcia-Milà *et al.*, (1993) suggest several possibilities that appear plausible in light of the way industries interrelate.

Growth

If a regional economy has a large share of an industry that relates closely with other industries, either through requiring many outputs from the other industries or producing important inputs for other industries, the growth pattern of the industry may be transmitted to other industries and thus affect the growth of the overall economy. That is to say, if the particular industry is fast growing, its demand/supply pull will make the supplier/demander industries grow faster. The reverse argument would apply for a slow growing industry, as its demand/supply drag, given its importance in the region, would make the interrelated industries grow more slowly.

A second mechanism through which a specific industry could influence the growth of the economy is agglomeration economies (Clusters) as previously discussed in Chapter two. To reiterate, agglomeration economies are defined in general as cost savings or productivity increases resulting from a geographic concentration of firms. If agglomeration economies characterise a specific industry rather than all industries, then a region with a high share of employment in an industry exhibiting agglomeration economies will experience a higher growth rate relative to regions with high concentrations of industries that do not exhibit agglomeration economies (this industry specific form of agglomeration economies is sometimes referred to as localisation economies see Heilbrun 1987, pp. 15-18).

Knowledge spillovers[157] are a type of agglomeration economies that can be important in this context and further associated with endogenous growth theory[158] (see chapter two section 2.1.4). If a specific industry devotes substantial investment in the types of R&D that have positive

[157] The effects of an activity which spreads beyond what it was originally intended to which Romer (1993) refers to as the intangible production knowledge factor. In endogenous growth models, the intangible production factor knowledge joined the tangible factor physical capital. Romer (1993) therefore speaks of idea gaps (lack of know-how), rather than of object gaps (a lack of investment) as being responsible for low development.

[158] Romer (1986) examined the idea that spillovers could be associated with the accumulation of knowledge and could be strong enough to outweigh the drag caused by decreasing returns to capital to sustain growth in per capita output.

spill-over effects on the productivity of other industries. A region with a high share of the R&D industry may have a higher overall level of productivity, and therefore a higher growth rate than other regions (output growth drives productivity). The spill-over effects of R&D can be negative if a region has a large share of an industry that devotes very little investment in R&D or invests in R&D that is not transferable to other industries. In that case, the relative lack of R&D spillovers will make the region grow slower than average.

Variation (Cycle intensity)

The interrelatedness of industries is also important in explaining the variability of a region's economy. If a region has a large share of an industry that is highly interrelated with other industries through supply and demand of inputs, and the industry is highly variable, its variability could possibly be transmitted to related industries, making the cycle more intense. In contrast, if the industry happens to be relatively weak but stable, that stability is likely to be transmitted to industries that will either provide or demand inputs from the stable industry, thus resulting in an economy that is less variable.

The intensity of the cycle in a region's economy may also be related to the breadth of the markets of the component industries of the region's economy. An industry that primarily produces goods and services to sell in the local market will not be able to look for alternative buyers outside the region when the local economy goes through a recession. In comparison, if the goods and services of a majority of the region's industries are sold in the national market, these industries can sell their goods on alternative markets during a local recession, effectively diversifying the risks of local shocks.

There are at least two difficulties with the theories summarised here. First the proposed theory on the growth and variability of economies is not complete. The industry mix is only one factor among many[159] that may affect the macroeconomic behaviour of economies. Secondly, alternative explanations for the link between industrial mix and growth or variability maybe as compelling as explanations involving interrelated industries, agglomeration economies, R&D spillovers and the extent of the market. For example if economies are open and workers migrate from one region to another, and if the more desirable region has an industrial mix that differs from the industrial mix of the less desirable region, then differential growth rates will be correlated with industrial mix but not caused by industrial mix. As another example, if, as it is argued by Barro and Sala-i-Martin (1991) there is an inverse relationship between growth rates and initial income per capita[160]. The latter is related to the industrial mix rather then the industrial mix could just be reflecting the historical development of the regions rather than providing an alternative explanation of differential growth rates.

Problems associated with Shift Share Analysis

When a technique is simple and apparently useful like shift share it is inevitable that it will be heavily criticized (Holden *et al.*, 1989). A majority of criticisms of the technique are confined to its use in regional growth analysis which is primarily based on articles by Thirlwall (1967), Mackay (1968), Buck (1970) and Stillwel (1970). Richardson (1978) summarises these articles and states the 'widespread applications are inappropriate' and that 'the primitive technique should be abandoned'. In addition Richardson (1978) identifies six deficiencies of the technique. These are discussed below and include the counter arguments:

[159] Chapter two identified the various determinants of growth.

[160] A slow growth region will grow faster as growth is easier from a low base.

i) ***The results are highly sensitive to the degree of industrial disaggregation.***

A general worry in shift-share applications has been the knowledge that results are not invariant to the level of industrial disaggregation. Richardson argues that the results are highly sensitive to the degree of disaggregation and that finer classification of industrial disaggregation produce smaller values for the differential component eventually reaching zero in the extremes case when each firm represents an industry. It is also argued that no one level of disaggregation can be theoretically justified and thus results are open for selection.

The usual purpose of standardising for industrial structure (and hence measuring its importance) is to make allowances for economic trends which influence employment change at the national level. In the widest sense these even include local factors, such as local labour shortages, in so far as they exert an influence on aggregate change. Fothergill *et al.*, (1979) point out that the main factors are always likely to be changes in aggregate domestic demand for products, changes in exports and imports and factors which influence national labour supply and labour productivity. Together these are the major influences on aggregate employment change and more importantly are the factors which differentiate one industry from another. Hence the essence of industry classification is to focus on the common characteristics of the member of a group (i.e. industry in our case) and to ignore the differences between group members.

ii) The choice of weights, e.g. as between the initial year and the end year, affects the results.

It is inevitable that results must change with the choice of base year, which is often argued to be the main weaknesses of the techniques. Fothergill *et al.*, (1979) argues that this issue is relatively straight forward in that the choice should be appropriate to the question being asked 'how would each region's growth differ from that actually experienced if each of its industries at the start of the period has subsequently grown at its national growth rate?', making it clear that the initial year should be used. In addition they provide evidence and argue that regional employment, industrial composition changes only slowly over time and for many the choice of the base year will make little practical difference.

iii) The differential component is highly unstable over time, and the degree of stability varies between industries

Authors such as Thirlwall (1967) and Richardson (1978) support the above listed deficiency, that the differential component does not display a consistent pattern hence invalidating shift share as a tool for generating employment projection. Where this instability is found to occur then it is true that simple projection is made more difficult. Conversely such instability need not be due to the technique but may be merely reporting what actually happens in the real world.

According to Moore *et al.*, (1977) in most cases the differential component tells a consistent story over time. In some regions the direction remains unchanged over long periods; in others the differential component clearly varies under external stimuli, the clearest of which has been the past UK Government's regional policy. Fothergill *et al.*, (1979) state that the lesson is surely to investigate the causes of the instability, hence shift share remains useful even if only to expose the instability.

iv) The true influence of the industrial composition is underestimated because the secondary multiplier effects from the structural component are concealed within the differential component

Mackay (1968) supports the idea that the technique underestimates the influence of the industrial structure, since any change in one industry will have an effect on other industries via multiplier effects and industrial linkages. Hence the industry mix may therefore contribute more to a region's growth than is reflected by the structural component. In short, part of the industry mix effect may be inextricably intermingled with all the other influences operating on the residual component.

Fothergill *et al.,* (1979a) estimated the size of regional multipliers in the UK, by drawing on Scottish input-output tables (Fraser of Allander Institute, *et al.,* 1978), finding that estimates for the long-run economic base multiplier on manufacturing vary between 1.42 and 1.28 depending on the region. The results were used to make estimates of the impact on the differential component of multiplier effects from the structural component. They revealed that the impact on the estimate of the differential component was not large. Despite these results it is imperative that the importance of multiplier effects is not ignored in the results of any shift share analysis. The best approach is undoubtedly to examine the likely effect on the differential component of realistic assumptions about the size of the multiplier effect from the structural component for each application. Nevertheless Fothergill *et al.,* (1979) shows as far as manufacturing is concerned, multiplier effects do not bias the results. Where shift share is applied to the service sector the conclusions will differ; here multiplier effects from other sectors will be of prime importance in determining the differential component.

v) ***A conceptual problem is that the technique tells us nothing about the capacity of a region to retrain growing industries or how to attract them in the first place.***

Richardson (1978) criticises shift share analysis as being *'merely a standardisation technique'* and argues that the technique *'tells us nothing about the capacity of a region to retain growing industries or how to attract them in the first place'*. This is true; since there are many things that the shift share technique does not do. However it is merely a standardised technique which allows us to make an important step in understanding the world, like most experimental controls in physical sciences. The differential component says nothing about the capacity of a region to grow, or why it grows, but when related to other variables it does allow the researcher to begin to test hypotheses in a meaningful way. The use of aggregate employment change not broken down into its main component parts, to test many hypotheses will make influences much clearer. This is because an important influence, industrial structure will also be at work and usually in a way unrelated to the factors under investigation.

vi) ***The differential component may be influenced by relatively spurious causes including the incorrect classification of firms, product heterogeneity within firms, and transfers of production between separate sites of individual firms.***

According to Buck (1970) the differential shifts can reflect random and sometimes spurious influences, such as misclassification of plants. Buck's main criticism was that even if the data could be trusted the 'differential growth is invariably the consequence of factors unrelated to geographical location' (Buck 1970). In his study he reported that the major factors influencing the differential component were inter-regional location subsidies and the reorganization of branch plants by companies, but that these were spurious.

Fothergill *et al.*, (1979) argues that it is important to make a distinction between the shift share technique and the data to which it is often applied. If the data quality is poor due to misclassification, this should not reflect a drawback of the shift share technique itself. In addition Fothergill *et al.*, (1979) argues that the employment data to which shift share is often applied are subject to random fluctuations and errors, and is at least as trustworthy as much other data that are used in econometric analysis. It is well acknowledged that researchers operate in a world of imperfect data, which means that no result ascertained from shift share analysis will ever be perfectly accurate. However this does not invalidate the technique as a tool for identifying the direction and broad order of the magnitude of spatial shifts. Fothergill *et al.*, also suggest that the work of Buck (1970) is a good example of important factors which the shift share techniques help to identify. Therefore, by steering the researcher towards looking for the reasons implying that the shift share technique has served a useful purpose.

Based on the premise that the shift share technique is considered not to be statistically sound, it is appropriate to validate the results ascertained from the shift share and to further apply them to well established statistical methods such as; non parametric tests and popular measures of inequality such as the coefficient of variation, Theil coefficient and Gini coefficient to provide validity which are discussed further below.

NON PARAMETRIC TESTS

Non parametric statistics are a branch of statistics that are applied when populations are not normal or there is severely skewed data; hence they are methods which do not depend upon the form of the underlying distribution. The non parametric statistics used are Spearman rank correlation and Kendall coefficient of concordance: W. These statistics are used to interrogate the shift share results.

5.8 Spearman Rank correlation

Within the Spearman rank correlation the ranking of sectoral productivity growth rates over time within the individual UK regions are consider so as to identify: the differences in productivity growth between sectors and regions; which sectors are driving productivity at the regional and national level; what sectors at the regional and national level have faster growth; assess whether manufacturing should be the principal driver for the North East; and examine the importance of manufacturing to the national and regional economy.

The aim of conducting a Spearman rank correlation is to examine whether change in the national industrial structure (the ranking of sectoral productivity growth rates over time) is similar at the regional level. Hence, whether the ranking of national and regional productivity growth rates are dependent. Dependency implies they are symbiotic:

H3: k sets of ranking are dependent

H3a: Manufacturing sub-sectors

H3b: Total Economy

Prior to discussing the Spearman Rank Correlation coefficient, the algebraic formula for calculating annual average productivity growth over time is available in Appendix 6 and the results have previously been discussed in Chapter 4 section. 4.9.1.

As noted earlier, the Spearman Rank Correlation Coefficient is a non-parametric test used to discover the strength of the associations between two variables when only ordinal data are available. The Spearman test calculates a statistic called *rho* (denoted as r_s), which measures the correlation coefficient between two sets of scores based on allocating ranks. Each set of scores is ranked separately and it is the difference between the ranks which are calculated. If the two variables are predicted to be positively correlated, entities that have low ranks on one of them should also have low ranks on the other; entities which are ranked highly on one should also be ranked highly on the other. However, if there is no correlation (i.e. a random distribution of ranks as stated by the null hypotheses), the two sets of ranks will not be related.

In the context of this thesis, once the sector productivity growth rates for the UK and each of the twelve UK regions were calculated, the performance of the various sectors was ranked. The UK sector productivity performance was ranked against each of the twelve UK regions.

The formula for the Spearman Rank Correlation Coefficient is as follows.

$$r_s = 1 - \frac{6\sum d^2}{n(n^2 - 1)}$$

Where;

n = the number of items or individuals being ranked: in the case of this thesis, there were a total of thirteen industry groups in the total economy and twelve industry groups in relation to the manufacturing sub-sectors.

d = the difference between the pairs; for example, the rank of industry A in the UK is 2 and the rank for the same industry in regions B is 1 - the difference between the two ranks is 1.

Problems associated with Spearman Rank correlation

The major disadvantage of the Spearman Rank Correlation Coefficient is the fact that the procedure is *nonparametric,* there are no parameters to describe and it becomes more difficult to make quantitative statements about the actual difference between populations. In addition it is argued that nonparametric procedures throw away information. Ranks preserve information about the order of the data but discard the actual values. But despite the fact that the Spearman Rank Correlation Coefficient is based merely on ranking it is able to capture the change in industrial structure over time when ranks change.

5.9 The Kendall coefficient of concordance W

The Kendall coefficient of concordance is, as noted earlier, another non-parametric statistical technique used for measuring the degree of correlation between a variable in a sample. It is also based on rankings like the Spearman rank correlation. The Kendall coefficient of concordance, W, measures the extent of association amongst several (k) sets of rankings of *n* entities. It is a useful technique in determining the associations among three or more variables. It has special application in providing a standard method of ordering entities, according to commonalities when there is no objective order of entities available.

The Spearman rank correlation measures the degree of association between two sets of rankings whereas the Kendall coefficient of concordance W, expresses the degree of association between several rankings. In this context, the productivity level of the twelve regions in a particular year and sector were ranked in ascending order; hence a region with the lowest productivity level was ranked 1 and a region with the highest productivity level was ranked 12.

At this point it is important to note that even though H3 and H4 are worded almost identically and are both based on ranking they actually consider different aspects of productivity. H3 ranks productivity growth rates whereas as H4 ranks productivity levels[161].

H4 will examine whether the productivity level rank position of a region in a particular sector is fixed over time. That is to say do regions with high/low productivity levels sustain the same high/low rank position over time; therefore K sets of ranking are independent. Furthermore, these results will enable us to identify whether there is any regional specialisation in certain sectors.

H4: K sets of rankings are independent

H4a: Manufacturing sub sectors

H4b: Total Economy

The formula for the Kendall Coefficient of Concordance is as follows.

$$W = \frac{s}{\frac{1}{12}k^2(n^3 - n)}$$

Where

$\frac{1}{12}k^2\left(n^3 - n\right)$ = maximum possible sum of the squared deviations, i.e. the sum s which would occur with perfect agreement among k rankings

161 Productivity levels refer to the amount of output per unit input at a point in time, whereas productivity growth rates are the percent change of productivity levels between two points in time.

k = number of sets of rankings; in this instance, the total number of years for which data are available (8 years: 1991, 1993, 1995, 1996, 1997, 1998, 1999, 2000).

n = total number of regions ranked. The total number of regions for which data are available in this instance is twelve regions (North East, North West, Yorkshire & Humber, East Midlands, West Midlands, East of England, London, South East, South West, Wales, Scotland and Northern Ireland)

s = sum of squares of the observed deviations from the mean of R_j that is;

$$s = \sum \left(R_j - \frac{\sum R_j}{n} \right)^2$$

j = a UK region (j = 1,2,.....n)

The method for determining whether W is significant from zero[162] (df = N-1) when N is larger than 7, is by calculating chi square, the formula for which is,

$$\frac{s}{\frac{1}{12} kn(n+1)} = k(n-1)W$$

and therefore

$$x^2 = k(n-1)W$$

By using this formula we may determine the probability associated with the occurrence under the H_o of any value as large as an observed W. If

162 W will be zero or positive. The reason that W cannot be negative is that when more than two sets of ranks are involved the rankings cannot all disagree completely.

the value of x^2 equals or exceeds that shown in the chi square critical value table for the particular level of significance and a particular value of df = N-1 , then the null hypothesis that K rankings are unrelated maybe rejected at that level of significance.

Problems associated with Kendall Coefficient of Concordance

Like the Spearman Rank Correlation Coefficient the Kendall coefficient of concordance is also based merely on rankings, thus does not capture the actual productivity level and the degree of difference within rankings.

5.10 Measures of Inequality

As noted earlier, the assessment of convergence/divergence trends typically involves the use of one or more indexes that measure the dispersion or degree of inequality in the variable: in the context of this thesis it relates to output per worker. The coefficient of variation has become one of the major indexes of dispersion used in regional analysis, together with the standard deviation. Furthermore, the Theil and Gini coefficients are another two standard inequality measures applied to assess the degree of inequality in the regional context. These measures of inequality are based on actual values which allow variances to be calculated, unlike non-parametric tests which are based on rankings (see Blackwood *et al.*, 1994 for a detailed review of the strengths and weaknesses of each measure).

The coefficient of variation measures the divergence of all observations of a series with respect to the general mean. The Theil coefficient is additively decomposable[163] inequality measure which decomposes total

[163] Additively decomposable measure is defined as the one which can be expressed as a weighted sum of the inequality values calculated for population sub-groups plus the contribution arising from differences between subgroup means. If Theil's measure demonstrates an increase in total and between size-group income inequality while

inequality into a *'between'* and a *'within'* set. For example in a study of changes in the composition of world income inequality within and between nations Goesling (2001) finds that between 1980 and 1995, income inequality within nations became an increasingly salient component of inequality in the world distribution of income, while between nation inequality declined in significance. The Gini coefficient is used to measure any form of uneven distribution. These three measures are discussed individually in greater depth below. They also enable us to understand whether regional or national economies are converging. Prior to discussing the three methods used, a brief review of the convergence concept is given below.

5.10.1 Convergence

The analysis of spatial inequality is concerned primarily with geographically averaged, per capita indicators, and when inequality changes are assessed over time, the process of interest is typically *convergence* (or *divergence*). The essence of convergence analysis is to investigate whether the "standard of living" gaps between regions fall over time. However, the term "convergence", has had different connotations in the recent literature. In particular, three definitions of convergence have been used in empirical analysis (Rey & Montouri, 1999; Sala-i-Martin, 1996).

Different types of economic convergence are routinely discussed and widely debated. Examples include convergence in per capita incomes between rich and poor parts of the European union; in plant and firm size in industries; in economic activity across different regions (states, provinces, districts or cities) within the same country; in asset returns and

within-group inequality weighted by income shares has declined, it can be inferred that between group inequality would show an increase in percentage terms. In Theil's index, within-group inequality is simply the weighted average of group income inequalities. (Bourguignon, 1979).

inflation rates across countries in a common trade area; in political attitudes across different groups; in wages across industries, and geographical regions.

Empirical analysis on the topic of convergence has assisted providing some insight into whether or not poor economies are catching up with richer ones. As is the case with many economic indicators, no single method of convergence measurement has been widely accepted. However, certain concepts have proved to be more influential and have helped to frame the debate. One of the earlier and more influential viewpoints was expressed by Barro and Sala-i-Martin (1991) whose definition of convergence refers only to convergence of output per capita. One notable limitation is that generally there has been a tendency to focus on a single economic variable while ignoring other relevant ones.

Barro and Sala-i-Martin (1991) separated convergence into two concepts, σ-convergence (or sigma-convergence) and β-convergence (or beta-convergence). σ-convergence refers to a decline in the cross-sectional dispersion of per capita income or product over time and is a measure of whether economies are moving together in the same cycle[164]. β-convergence occurs when poor regions grow faster than rich regions. β-convergence has two fold connotations, absolute and conditional convergence. Absolute β-convergence occurs when economies with lower initial level per capita income grow faster than ones with higher initial per capita income. Conditional β-convergence takes into account other differences across countries above and beyond initial levels of income. For example, differences in the initial levels of technology or saving can lead to different steady states. Therefore, countries do not

[164] It is typically measured by a measure of dispersion such as the standard deviation of income , the coefficient of variation or the Gini coefficient.

need to converge into the same steady state[165] as in absolute β-convergence. The theory of conditional convergence states that the poorer an economy relative to its steady state the faster output per worker will grow. Simply, it is not whether a country is poor or rich but whether it is poor or rich relative to its steady state.

It should be further noted that convergence, in its various forms, does not imply that income becomes equal in all regions. Therefore the convergence process is not supposed to proceed indefinitely. In theory, convergence is supposed to drive the system toward a steady state in which income inequality reaches an equilibrium condition that reflects a different endowment of exogenous factors, productivity levels, other structural characteristics of the regional economy.

The three convergence concepts, convergence, absolute-convergence and conditional-convergence have been widely applied and have been usually considered together in empirical studies (Rey & Montouri, 1999; Sala-I Martin, 1996b). In addition to the three convergence concepts described above there exists another form which comes from time-series studies, and has been defined as stochastic convergence. This type of convergence implies that in the long run, forecasts of income level differences between two economies goes to zero (Rey & Montouri, 1999). This particular type of convergence has not received much attention due to the availability of consistent and comparable data. Long and dense time series for small geographic units are difficult to obtain.

[165] There are distinct policy implications where regions experience different steady state incomes. Such differences reflect differences in structural factors which will be more or less important depending on the size of the observed steady state differences. Differences in human capital or in the style of an economic regime represent structural differences. Unless those change one cannot expect a narrowing of income disparities; hence the case for regional policy so as to improve structural weaknesses (Capacity building).

Convergence Variables: A review

A majority of earlier empirical work ((Barro & Sala-i-Martin, 1991; 1992; Armstrong, 1995; Rey & Montouri, 1999) dealt with income per capita. However, Anderton *et al.*, (1992) highlighted that convergence does not only involve GDP per capita and separated the idea of convergence into three categories:-

1. Structural convergence variable; which is the assimilation of economic institutions and practices.

2. Nominal convergence variable; which is the convergence of the development of cost and prices and their underlying determinants such as disinflation, and declining exchange rate volatility.

3. Real convergence variable; which refers to the convergence of real working conditions and living standards. (GDP is one of the main indicators used to measure real convergence). Luengo (2001) explained that real convergence involves elements such as employment and unemployment, salaries, labour productivity and productive specialisation.

More recently, authors have been shifting their focus away from GDP per capita (see Foley & Marquetti, 1999; Esteban, 2000; Tsionas, 2000) which is based on the population. Instead they have chosen to use productivity which is based on employment as the main indicator. Tsionas (2000) suggested that if technological convergence which can be implied from total factor productivity does not occur then countries and regions are not catching up, and per capita output in rich and poor countries will tend to become more unequal. Klenow & Rodreguez-Clare (1997) argued that differences in productivity are the main cause of cross country dispersion in income per capita. This latter statement is supported by the findings of

Esteban (2000). He showed that output per worker still accounted for two thirds of the recorded inequality in per capita income in Europe. The OECD (2001d) confirmed that the differences in the GDP per capita in OECD countries are attributable to differences in labour productivity.

Problems associated with measuring

Previous work on convergence has tended to focus on a particular economic indicator exclusively, even though there are multiple components of the convergence process. Hence one notable limitation is that there is a general tendency to focus on a single economic variable, while ignoring other relevant ones. At best, this approach represents a considerable oversimplification of real work complexities. At it's worst, it also has the unfortunate effect of obscuring further inquiry into what is most certainly a multifaceted process. In describing convergence as a one-dimensional phenomenon, the possibility that there may be considerable differences in convergence rates for different factors is ignored. Certain types of convergence may be relatively rapid; others may be extremely slow. For others, it may even fail to exist at all. Policy implications for a particular region are immediately derivable from a more comprehensive examination of the convergence picture by noting the areas of success and the areas where improvement is needed.

Although it is not the scope of this thesis to review the theoretical debate on the convergence hypothesis, it should be briefly mentioned that much of the controversy surrounding regional convergence arises from the debate of two opposing growth paradigms, the neo-classical growth theory and the endogenous growth theory. These two approaches have substantially different policy implications. In essence, according to the neo-classical perspective, convergence is due to the presence of diminishing returns to capital. Since the convergence process will operate to reduce the initial income differentials, policy interventions to correct territorial disparity are viewed as unnecessary. In contrast, according to the endogenous growth theory the presence of increasing returns to scale lead to the possibility of persistent or even widening levels of regional income disparities.

The research focus on the convergence hypothesis is therefore seen as a means to test these two competing theories of economic growth. Yet the empirical evidence and theoretical and methodological foundations of this type of analysis continue to be the centre of intense debate. Two articles capture the main points of the controversy (for further details see Quah[166], 1996a; Sala-i-Martin[167] 1996).

Understanding whether differences in income per capita across regions diminish or increase over time can be gained from the development of an indicator of income dispersion. The most frequently used measures for the dispersion of income are the standard deviation and the coefficient of variation (for further indicators see Molle *et al.*, 1980). In the context of this thesis the income per capita indicator is translated to output per worker. Hence it is the dispersion of productivity that is of concern as opposed to the dispersion of income.

One of the problems with empirical studies of the rate of convergence in per capita income is that they fail to take spill-over effects from neighbouring regions into account. For example, strong trade and labour market linkages between neighbouring regions, suggest that a single

166 Quah suggests that the concept of β-convergence is misleading in understanding convergence. His critique is both methodological - studying an average or representative economy gives little insight into the empirical behaviour of the entire cross-section - as well as technical - the law of convergence may be partially explained by a statistical artefact, the unit roots in the time series data.

167 Sala-i-Martin argues that convergence is, together with other convergence concepts, a relevant one. He also points out that although statistical problems are theoretically possible they are unlikely to be the cause of the observed convergence.

region's economy is likely to be affected by changes in per capita income occurring in neighbouring regions. One effect of these intra-regional linkages is that regions tend to display similar convergence trends near their neighbours. This has been found to occur for example in the USA by Rey and Montouri (1999). They also show that allowing for these spill-over effects reduces the estimated convergence rate, though only marginally for the US states over the period 1929-94.

The coefficient of variation is an attribute of a distribution and is the standard deviation divided by its mean; it is one of the most popular measures for the dispersion of inequality. In the context of this thesis it is used to assess whether the gap of relative output per worker is widening or declining over time.

*H5: Comparing regions, there is no variation in the dispersion of productivity levels amongst sectors over time **(regions)***

H5a: Manufacturing sub sectors

H5b: Total Economy

*H6: Comparing sectors, there is no variation in the dispersion of productivity levels amongst regions over time **(sectors)***

H6a: Manufacturing sub sectors

H6b: Total Economy

5.11 Algebraic formula for calculating Coefficient of Variation

As noted earlier, standard deviation and the coefficient of variation are the most popular techniques used to measure dispersion. This method measures the divergence of all observation of a series with respect to the general mean. The formula for calculating the coefficient of variation is as follows:

Standard deviation

$$\sigma = \sqrt{\sum_{i=1}^{n} \frac{\left(x_i - \bar{x}\right)^2}{n}}$$

The coefficient of variation is the standard deviation expressed as a ratio.

$$CV = \frac{\sigma}{\bar{x}}$$

Where in the context of this thesis the terms are defined as:

x_i = Output per worker in industry i

$\bar{x}$ = Average output per worker

n = Number of observations (Industry Groupings TE = 13, MSS = 12)

$\frac{\sigma}{\bar{x}}$ = CV = Coefficient of Variation

In the context of this thesis the coefficient of variation calculation was first applied to individual sectors of the economy (as illustrated by the formula above) and then applied to the individual regions. In both instances the formula was applied to two additional categories, manufacturing sub sectors and the total economy.

Problems associated with Coefficient of Variation Method

The coefficient of variation is only able to provide us with a time series trend line, which may move up and down or remain constant. Therefore we need to understand whether changes are statistically significant. By that we mean, is this effect generalisable in terms of output per worker in regions/sectors. In essence the results are general; hence regression analysis together with a single sample *t*-test is further applied to test H5 and H6.

5.11.1 Regression

A regression line, or the best fit line, is a straight line that describes how a dependent variable, i.e. y (output per worker) changes as an independent variable, x (year), changes. A regression line is often used to predict the value of y for a given value of x. In this instance regression will be applied to the coefficient of variation results, where *b* in the formula below represents the regression coefficient.

$$b = \frac{\Sigma(x-\bar{x})(y-\bar{y})}{\Sigma(y-\bar{x})^2}$$

Problems associated with Regression

One of the weaknesses of regression analysis is how outliers (here being any dramatic change in the industrial sectors) can heavily influence the results. As the sample size gets smaller, there is a greater chance that small regional sectoral shifts can affect the results. If there are any extremes or outliers, the relationship identified could be under or overstated.

5.11.2 *t* - Test

In order to understand whether the results ascertained by the coefficient of variation are statistically significant a single sample *t*-test will be performed so as to determine whether the sample has been drawn at random from a population with a well known mean. This will help to establish whether it is from a different population. A single sample *t*-test is used as the parameters of the underlying population are already known and also used to assess the probability of drawing our sample at random from that population.

As discussed in the earlier paragraph calculating the coefficient of variation is not sufficient hence it is important to consider the statistical significance of the convergence or divergence in a sector or region. The test is two-tailed as the difference from zero can be positive, meaning that inequality maybe divergent, or negative, indicating that the inequality maybe convergent. The formula for calculating the t-test is as follows:

$$t = \frac{\bar{X} - \mu}{S\bar{X}}$$

Where

t = test statistic

$\bar{X}$ = sample mean

μ = population mean

$S\bar{X}$ = standard error of the mean

Problems associated with the t- Test

One of the main cited criticisms of the *t*-test is that it is limited to data that satisfy parametric assumptions of the test. However despite this critique the *t*-test is generally considered to be more power efficient, that is to say better at detecting genuine differences than its non-parametric equivalents. In addition it is sensitive to features of data collected and is considered to be more robust, meaning that these assumptions about data may be violated substantially whilst still obtaining fairly accurate probability estimates (Coolican, 2004).

5.12 Theil – Inequality Measures

A type of question frequently encountered in the analysis of income inequality concerns the extent to which inequality in the total population can be attributed to differences between major population subgroups. For instance, interest may lie in the quantitative significance of incomes variations associated with age, sex, race, the level of education, region, etc., which enable the examination of how the overall degree of inequality can be resolved into contributions due to (i) inequality within each of the subgroups and (ii) inequality between groups, that is due to variations in average levels of income across subgroups. To this effect the Theil coefficient, a popular additively decomposable (meaning that the measures can be decomposed into the sum of between and within components) inequality measure is applied. The Theil coefficient was developed by Henri Theil (1967) to measure the amount of information conveyed by a single message that an event has occurred. It was derived from a study of what Theil called the information concept. Like the coefficient of variation the Theil coefficient equally weights all observations in the distribution. The Theil coefficient is a decomposable coefficient which means that observations are grouped in mutually exclusive and completely exhaustive groups, the total inequality (I_{tot}) measured by the index can be decomposed into a between-group component $(I_{between})$ and a within-group component (I_{within}) Thus, total inequality can be written as: $I_{tot} = I_{between} + I_{within}$.

The decomposition of income inequality into its component parts is valuable for two particular reasons. Firstly, it supplies additional information about the sources of inequality change. Secondly, the break-up isolates the part of the overall inequality which the society should care about most from the part which may be simply due to change in the demographic composition or some other factors which are not very relevant for public policy (Lindert *et al.*, 1976). The first part indicates the extent of inequality to be tackled by the policy makers, while the second part indicates the secular trend of inequality which a society cannot avoid[168].

[168] Kuznets (1963) would call the first part 'unwarranted inequality' and the second part 'warranted inequality'. Danziger *et al.*, (1976) calls the first 'non-functional' or 'policy relevant' inequality and the second 'functional 'or 'policy-irrelevant' inequality.

According to Alasia (2002) the Theil's index has all the desirable properties of an inequality measure. It is symmetric (invariance under permutations of individuals), it is replication invariant (independent of population replications), it is mean independent (invariant under scalar multiplication of income), and is satisfies the Pigou-Dalton property (inequality increases as a result of a regressive transfer).

The proposed null hypotheses are:

H7: No variation of inequality within and between regions over time

H7a: Manufacturing sub sectors

H7b: Total Economy

H8: No variation of inequality within and between sectors over time.

H8a: Manufacturing sub sectors

H8b: Total Economy

To reiterate once again, the Theil coefficient is given by:

$$I_{tot} = I_{between} + I_{within}$$

Where

(I_{tot}) = Total inequality

$(I_{between})$ = This measure explains inequality *between* groups

(I_{within}) = This measure explains the inequality *within* the group

Two separate formulae are used to calculate the '*within*' inequality and the '*between*' inequality coefficient. A specialised formula (Shorrocks, 1980) which encapsulates our variables with regards to productivity levels in regions is given below.

The formula for calculating inequality *between* $(I_{between})$ a region is as follows:

$$B = \frac{1}{n}\sum_{g} n_g \log\frac{\mu}{\mu_g}$$

(Inequality between regions)

Where

B = Degree of inequality between regions

$\frac{1}{n}$ = Total number of sectors ie. Total economy 13 and

Manufacturing sub sectors there are 12

$\sum_{g}$ = Sum of the 12 regions

n_g = Number of sectors of g regions

μ_g = Mean regional output per worker each year across the total economy /manufacturing sub sectors

μ = Mean output per worker each year across the total economy /manufacturing sub sectors

n = Sectors

g = Number of regions

The formula for calculating inequality *within* (I_{within}) a region is as follows:

$$C_g = w_g I\left(y^g\right) = \frac{1}{n}\sum_{i=1}^{n_g} \log\frac{\mu_g}{y_i^g}$$

(Inequality *within* regions)

Where

C_g = Degree of Inequality within regions

n = Region

g = Number of Observation (12 Regions)

μ_g = Mean regional output per worker each year across the total economy /manufacturing sub sectors

y_i^g = Mean regional sector productivity

The formulae above are applied to regions, whereby the symbol g relates to regions. The formulae are then applied to sectors where g is translated to a sectors. The Theil coefficient is a number between one and zero. A value of zero indicates homogeneity and an increasing value indicates increasing disparity therefore heterogeneity.

Problems associated with Theil

One of the main cited critiques associated with the use of the Theil coefficient technique is the quality of the data being used and the degree of industrial disaggregation. In addition the Theil coefficient is unable to explain the causes of disparities.

5.13 Gini coefficient - Inequality Measures

The Gini coefficient is a measure of inequality often used in the analysis of income disparity; it can also be used applied to other measures such as in this case to measure productivity inequalities. The Gini coefficient is a number between 0 and 1, where 0 corresponds with perfect equality (where all regions/sectors have the same productivity levels) and 1 corresponds with perfect inequality (where one region/sector has the highest productivity level, and other regions/ sectors have a zero productivity level). Here the extent of inequality amongst North East's sectors is considered so as to determine whether there is perfect equality.

H9: Perfect equality in productivity levels amongst the North East's sectors.

H9a: Manufacturing sub sectors

H9b: Total Economy

In the context of this thesis, the Gini coefficient is an indication of the extent to which there is variation in labour productivity between sectors; hence the degree of labour productivity inequality between sectors.

$$\text{Gini} = \sum_{i} \left[\left(y_i^{cs} + y_{i-1}^{cs} \right) \cdot \left(Pop_i^{cs} - Pop_{i-1}^{cs} \right) \right]$$

y = output

$_i$ = is the subscript for the *i*th territorial unit (Sector)

Pop = employment

^{cs} = indicates cumulative shares

The Gini coefficient was calculated for the twelve regions of the UK for each year. The significance of Gini is that it measures the ratio of areas; that is, it orders all observations and then plots the cumulative percentages of output against the cumulative percentage of employment.

Problems associated with Gini

One of the main problems associated with the Gini coefficient is that it is sensitive to both high and low extremes of employment/output distribution. As for all statistics, when collecting the data initially, there will always be systematic and random errors. If the data are less accurate, then the Gini coefficient has less meaning and may understate the actual amount of inequality if the situation is that richer regions are able to use their resources more wisely than poorer regions. Also, as noted earlier, the Gini coefficient is unable to explain causes of disparity; hence the Theil coefficient is often used in conjunction with the Gini Coefficient due to its decomposability properties. Despite these weaknesses the Gini coefficient remains popular for its clarity and its ease of geographical representation.

5.14 Problems associated with measures of inequality

Each measure of inequality suffers from distinguishable limitations and drawbacks. Each of these indices is more sensitive to changes in a different range of the income distribution, meaning that each result in a slightly different trend and each has specific properties (see Kovacevic & Binder, 1997).

The coefficient of variation is more sensitive to high income values. The Gini is sensitive to both high and low extremes of income distribution and remain popular for its clarity and its ease of geographical representation. While the Gini coefficient offers a more easily interpretable picture of inequality, the Theil index has all the desirable properties of an inequality measure.

However all the methods, shift share analysis, non parametric tests and the measures of inequality, suffer from notably similar limitations in that they fail to capture spill-over effects, multiplier/network effects, and agglomeration economies. They also fail to explain growth triggers and to explain the cause of the disparity (see Chapter two where the major theories in the explanation of regional disparities are discussed). Despite these inadequacies the various methods discussed provide robust reliable results based on the statistical test further applied.

Conclusion

This chapter has presented nine principle hypotheses which aim to appropriately investigate and examine the role of manufacturing with regards to productivity (refer to Appendix 12 for a list of the hypotheses). These hypotheses can essentially be divided into three very broad groups, the first examines the structure of the regional economy, the second examines the performance of the various sectors of the economy and the final function is to consider inter-regional inequality. H1 and H2 examine the structure of the economy. H3 maps the sectoral productivity growth of a region onto the nation, whilst H4 examines regional specialisation. The measures of inequality on which H5 - H9 rest consider the various aspects of inter-regional inequality.

Therefore the aim of this chapter was to describe and critique the data sources and methodology which underpin this empirical investigation. It commenced by introducing the various measures of productivity of which output per worker based on value added will be the focus of this investigation. Thereafter the main data source was discussed together with a critique of the data set. The methodology was then introduced and underpinned by the previous chapters. Shift share analysis was reviewed, which primarily aims to divide a region's employment growth and output per worker as in this instance (over a given time) into three components. The first indicates the contribution of the region's particular mix of industries to its overall growth rate. The second reflects the combined effect of all other factors affecting the regions growth; and the third is the region's share of national growth. Thereafter two distinct approaches within the methodology were outlined those being non-parametric tests and the other being measures of inequality.

Shift share analysis is the keystone of this empirical investigation; it is not a theory, it is an identity. Shift share analysis is only a descriptive tool and it does not determine a region's economic potential. Shift share analysis does not account for many factors, including the impact of business cycles, or identification of actual comparative advantages and differences caused by levels of industrial detail as previously noted. Based on these rationales it is unreasonable to expect it to be capable of providing a comprehensive explanation of why some regions grow quickly while other regions grow slowly, an aspect for which it is strongly criticised. It is simply a 'snap shot' of a local economy in two points in time. Therefore the analysis may not offer a clear picture of the local and national economies since the results are sensitive to the time period chosen.

However, it is a useful way of starting to look at industrial change in an area and would be useful for targeting industries that might offer significant future growth opportunities. The shift share analysis was applied to an original data set constructed by the author.

The shift share analysis, despite these criticisms, has a useful role to play in explaining regional growth differences in that it measures the contribution of a region's industry mix to its performance. In an article titled "In Defence of Shift Share", Fothergill *et al.*, 1979 agued that;

> *"...the widely held misgivings are not strong enough to seriously affect its application to the analysis of regional growth in the UK. The technique is reasonably robust in that general conclusions are not usually seriously distorted by the potential difficulties in using shift share".*

Additional well established statistical methods such as non-parametric testing and popular measures of inequality such as the coefficient of variation, Theil coefficient and Gini coefficient are used to provide validity. The coefficient of variation measures the divergence of all observations of a series with respect to the general mean. The Theil coefficient is a decomposable coefficient which decomposes total inequality into a between and within set. The Gini coefficient is a one effect coefficient.

Such measures of inequality are embedded in the notion of convergence. Past research on the topic of convergence has largely proceeded by using a single indicator to make the determination of whether or not convergence has occurred. In examining the different regional economies of the UK, the concepts of income inequality and economic growth are closely related. If poorer economies are growing faster than richer ones, income inequality will be decreasing. Such economies are said to be converging towards one another. Conversely, if poor economies are growing more slowly than richer ones, then income inequality will become greater over time and such economies are said to be diverging from one another. To reiterate, there are essentially two types of convergence. There is beta convergence (β-convergence) and sigma-convergence (σ-convergence). Armstrong *et al.*, 2000 described the two as follows;

> ***β-convergence*** *occurs when poor regions grow faster than rich regions. This implies a negative relationship between the growth of per capita income (over several decades) and the level of per capita income at the start of the period.*
>
> ***σ-convergence*** *is a more conventional measure of income inequality and is simply a measure of the dispersion of per capita income between regions at a given point in time. Convergence occurs in this case when the dispersion of the per capita income falls between regions (though not necessarily between people within regions) over time.*

Therefore it is evident that using only one variable in isolation considers only a small piece of the overall convergence picture. For example, the U.S.A. which has a very high GDP per capita has had a lower level of productivity growth than several developing countries. According to the OECD (2001d), the gap between GDP per capita and productivity levels is even more prominent in European countries, namely France, Italy and the Netherlands. These countries have productivity levels that are higher or comparable to that of the U.S.A., but GDP per capita levels that are lower. Countries with low growth but high productivity may have a better chance to catch up than other countries with higher growth. Nevertheless high labour productivity is not necessarily associated with high employment; the relationship may be negative. High labour productivity could be due to high capital-labour ratios and to difficulties in keeping low productivity workers in employment (OECD, 2001d).

Chapter 6: Cross Regional Differences

Introduction

Chapter two set out the major theories in the explanation of regional growth together with the various determinants of growth of which the industrial structure of a region was considered to have an effect on a regions' growth trend path and vice-versa. Chapter three introduced the slow growth performance of the North East in relation to its UK regional counterparts and set out the Government's ambition of achieving high and stable levels of growth and employment which encompassed improving the economic performance of every region of the UK to ensure convergence. In addition two determinants of growth were identified employment and productivity as well as five drivers of productivity which were contextualised in relation to the North East. Chapter three revealed that the North East was the worst performing region in relation to the two determinants of growth (which also included five drivers of productivity). Chapter four considered the role of manufacturing as it is a prominent feature of the North East economic landscape. Section 5.5 of Chapter five introduced the data set constructed which revealed that the output per worker gap between the UK and the North East was widening with regards to the total economy and the manufacturing sector; hence leading to divergence. Chapter five also introduced several hypotheses which can be broadly broken down into two parts. The first part aims to consider the role of the industry mix in explaining the poor performance of the North East, and the second part aims to assess whether differences in output per worker across regions and sectors are diminishing or increasing over time.

This chapter will discuss the results obtained in relation to the former part of the empirical investigation and those proposed null hypotheses (H1-H2) introduced in Chapter five. The primary aim of this chapter is to examine:-

- the extent to which regional and national aggregate employment change differences are accounted for by a region's industry mix, and
- the role of the industry mix in explaining regional and inter-regional inequalities in output per worker.

6.1 Shift Share Analysis - Regional Employment Growth

As explained earlier in Chapter five section 5.7, shift share analysis is a technique originally proposed by Dunn (1960) for measuring regional aggregate employment change over time (usually as indicated by employment). Recent applications include the use of indicators such as income, value added and number of establishments.

> *"The shift share technique has a single specific purpose. It allows investigators to measure or to make some allowance for the degree to which some structural characteristics account for the differences between categories of an overall population. Theses categories are most frequently (but not necessarily) spatial ones, regions for instance."* (Fothergill *et al.*, 1979)

The essential idea is to analyse the extent to which the difference in employment change between a region and the national average is due to a region performing uniformly better than average on all industries or to the fact the region happens to be specialised in fast growing sectors. The principal proposed hypothesis to be tested is:

H1: The North East's industry mix does not explain the difference between national and regional employment change.

And the sub hypotheses are:

H1a: Manufacturing sub sectors

H1b: Total Economy

The shift share model decomposes economic change into three additive components; the residual, structural and the national component. The residual component incorporates all factors not related to the activity structure. Some of these are region specific, such as a lack of entrepreneurship, the inefficiency of public polices with regards to unemployment, and a poor allocation of public expenditures. The structural component measures the industrial composition of the region and reflects the degree to which the local area specialises in industries that are fast or slow growing nationally; hence if a region contains a relatively large share of industries that are fast/slow growing nationally it will show a positive/negative structural component. Finally national component measures the regional employment change that would have occurred if regional employment had grown at the same rate as the nation.

According to Table 50 below as far as the manufacturing sector is concerned Northern Ireland was the only region which experienced a growth in manufacturing employment (0.82%), however it did so not because of a favourable mix of industries (-4.21%) but mainly because of the better than average performance of industries in its region.

The residual component is simply the part of a region's growth that remains unexplained and is interpreted as the part of the region's employment growth performance which is attributable to regional specific factors, as explained earlier. A positive residual means that a region's growth rate has exceeded the growth rate that would have occurred if each industry in the region had grown at the same rate as its national counterpart. A negative residual means the reverse. According to Table 50 seven of the twelve regions show a negative residual component with the remaining regions showing positive residual components. The North East had the highest negative residual component of -5.55% and Northern Ireland had the highest positive residual component of 10.76%. In some cases the residuals are large relative to the structural component.

Table 50: Shift Share analysis of UK regions 1991-2000 (All Manufacturing)

		Components of the shift share identity		
	Region's employment growth %	Growth to due to other factors %	Growth due to industry mix %	National growth %
		Residual Component	*Structural Component*	*National Component*
	Standard Shift Share All Manufacturing			
NE	-15.50236	-5.55227	-1.09173	-9.95009
NW	-13.33372	-3.38363	-1.46410	-9.95009
YH	-11.40772	-1.45763	-2.32643	-9.95009
EM	-10.30071	-0.35062	-5.11681	-9.95009
WM	-13.66067	-3.71058	0.24721	-9.95009
E	-9.09295	0.85714	3.09132	-9.95009
L	-12.12897	-2.17888	2.90258	-9.95009
SE	-3.37637	6.57372	3.65608	-9.95009
SW	-1.09357	8.85652	2.05861	-9.95009
W	-2.40906	7.54103	1.71318	-9.95009
S	-14.98361	-5.03352	-1.35381	-9.95009
NI	0.81525	10.76534	-4.20928	-9.95009

Source: Author's calculations

Table 50 shows the East of England, West Midlands, London, South East, South West and Wales had a markedly favourable industry mix compared to other regions of the United Kingdom as can be seen from the positive values of the structural component. In addition these regions have done better relatively. On the other hand the North East, North West, Yorkshire & Humber, East Midlands, Scotland and Northern Ireland have an unfavourable mix of industries in the manufacturing sector which is apparent from the negative structural component values.

Overall employment in the manufacturing sector of all the regions would have declined by 9.95% as can be seen by the national growth component column. Northern Ireland was the only region that experienced positive employment growth in manufacturing, whereas the remaining eleven regions all experienced a below national average employment decline. The East of England, South East, South West and Wales regions experienced a less than national average employment decline; conversely the North East, North West, Yorkshire & Humber, East Midlands, West Midlands, London and Scotland demonstrated an above average decline. The North East suffered the highest employment decline of 15.50%.

Table 51 below shows the shift share results obtained for the total economy. All the regions experienced employment growth during the period 1991-2000, the South East experienced the highest employment growth of 27% with the North East experiencing the lowest employment growth of 7%. Of all those regions the East of England, South East, South West and London area experienced above average national employment growth.

Table 51: Shift Share analysis of UK regions 1991-2000 (Total Economy)

		Components of the shift share identity		
	Region's employment growth %	Growth to due to other factors %	Growth due to industry mix %	National growth %
		Residual Component	*Structural Component*	*National Component*
	Standard Shift Share Total Economy			
NE	7.05480	-10.76148	-1.45463	17.81628
NW	15.98670	-1.82958	-0.87709	17.81628
YH	13.75017	-4.06611	-1.43036	17.81628
EM	15.27685	-2.53943	-3.35001	17.81628
WM	13.41448	-4.40180	-3.03096	17.81628
E	20.84147	3.02519	-0.13243	17.81628
L	25.42207	7.60579	5.31309	17.81628
SE	27.59760	9.78132	1.59176	17.81628
SW	18.76198	0.94570	-0.67371	17.81628
W	13.67569	-4.14059	-2.55358	17.81628
S	12.67739	-5.13889	0.47966	17.81628
NI	16.73163	-1.08465	-4.11777	17.81628

Source: Author's calculations

Only four of the twelve regions showed a positive residual component with the South East yielding the highest positive residual component (9.78%); the remaining eight regions demonstrated a negative residual component. The North East yielded the highest negative residual component (-10.76%), which as noted earlier is interpreted as the part of the regions employment growth performance which is attributable to regional specific factors such as regional entrepreneurship, location, regional policy, migration etc. It is evident from chapter three that that the North East performance in relation to employment and productivity and the factors underlying productivity is near or at the bottom of the league, performing poorly compared to the national average, and relative to its regional counterparts.

The negative structural component results in Table 51 for the following regions show an unfavourable industry mix; North East, North West, Yorkshire & Humber, East Midlands, West Midlands, East of England, South West Wales and Northern Ireland. Northern Ireland has the most unfavourable industry mix of all the regions. Conversely regions which show a favourable industry mix are London, South East and Scotland as can be seen from the positive structural component. Moreover, London shows the most favourable industry mix.

The results in Table 51 provide evidence that a region's industry mix is associated with regional disparities in employment growth during 1991-2000. The regions experiencing the fastest employment growth (London and South East) had the most favourable industry structures; and conversely, those regions with slow employment growth (such as North East) had the least favourable industry structures.

The national growth component column shows employment in the regions would have grown by 17.81% had each industry in each region grown at the same rate as the corresponding national industry.

Upon comparison of the regional employment shift share results for the total economy and the manufacturing sub sectors the following emerges:-

- Nationally manufacturing employment declined by 9.95% whereas employment for the total economy increased by 17.81%
- Seven of the twelve regions experienced a decline in manufacturing employment more than the national average; as opposed to only four regions experiencing employment growth above the national average for the total economy.
- Of the 12 regions the North East experienced the greatest proportionate employment decline in manufacturing employment and the smallest increase in employment growth for the total economy.
- Northern Ireland was the only region to experience an employment growth in manufacturing.
- The South East experienced the greatest employment growth in the total economy well above the national average.
- Of the 12 regions the North East showed the greatest residual value component for both manufacturing and the total economy; hence region specific factors.
- More regions show a negative value for the industry mix component in the total economy (9 regions) compared to the manufacturing sub sectors (6 regions). i.e. the total economy differs more.

The proposed hypotheses: - *H1*: *The North East's industry mix does not explain the difference between national and regional employment change.*

H1a: Manufacturing sub sectors

H1b: Total Economy

Both hypotheses (*H1a & H1b*) are rejected with regards to the North East, on the grounds that the shift share results in both instances reveal a negative industry mix component implying that the North East has an unfavourable industry mix which is making it difficult to generate employment growth; showing there is an association between industry mix and relative employment growth. However based on the premise that the negative residual component outweighs the industry mix component in both instances (Table 50 & Table 51); the evidence reveals that, while the industry mix does have a part to play, it is not substantial enough to warrant the supporting hypotheses *H1a* and *H1b*. It is important to note the implicit assumption (with regards to the shift share results in Table 50 & Table 51) that each industry is independent of any other industry. Hence it is assumed that one industry has no influence whatever on any other industry; the results may conceal significant intra-industry relationships such as income multiplier effects or input-output relationships[169] as pointed out by Mackay (1968) and previously discussed in chapter five section 5.7.2.

6.2 Shift Share Analysis – Output per worker

As noted earlier in the previous chapter, section 5.7, shift share analysis is essentially a technique used to indicate the difference between national and regional change, whereby in this instance UK and North East sectoral employment levels for the period 1991 and 2000 are used to compute the shift share components so as to provide a cross sectional

[169] Technological linkages might have the result that a fall in output in one industry will lead directly to a fall in output and incomes in other industries (and vice-versa)

comparison. Esteban (2000) modified the technique to capture output per worker. With regards to this thesis UK and North East sectoral productivity (output per worker) levels for an individual year are used so as to provide a time series movement of the various shift share components. To this end shift share analysis is used to examine the role of differences in sectoral productivity and in the industry mix in explaining the inter-regional differences in output per worker. Unlike the employment shift share analysis conducted in the previous section the three components are labelled slightly differently so as to capture output per worker.

To reiterate the three components once again; the first component is the industry mix which is represented by the symbol μ_i. The industry mix component assumes that sectoral productivity in a region is equal to the national average therefore this measures differential productivity accruing from a region's specific sectoral composition. The second component is the productivity differential which is represented by the symbol π_i. The productivity differential component focuses on the contribution of sectoral productivity differences to the shift between regional and national average productivities; in addition the national industry mix is imposed. The third component is an interactive variable, the allocative component, which is represented by the symbol α_i. The allocative component is an interactive variable which measures the covariance[170] between the industry mix and productivity differential components, which are sectoral specialisation and productivity advantages[171]. This component can be interpreted as the contribution to regional growth deriving from its specialisation in those

[170] The covariance measures the extent to which two variables move up and down together relative to their individual means.

[171] The allocative component is an interactive variable which observes the inter-relationship between the two components (Industry mix and productivity differential) which would otherwise be missed out.

activities where the region is most competitive. In addition the allocative component is an indicator of the efficiency of a region in allocating its resources[172] over the different industrial sectors. Finally Y_i shows the gap between the regional and national average productivity levels additively decomposed into the three components. The null hypotheses proposed are as follows: - *H2: The North East's industry mix does not explain the difference between national and regional output per worker.*

H2a: Manufacturing sub sector

H2b: Total Economy

Table 52 (manufacturing) and Table 53 (total economy) below show the North East results (the regional deviation in productivity levels) obtained from the shift share analysis as broken down into the three components.

6.2.1 North East Manufacturing Shift Share Results

The industry mix component results for the North East's manufacturing sub sectors in Table 52 show that over time this component has declined from being +1.07750 in 1991 to +0.36845 in 2000, which reveal that the region's sectoral composition is converging to the national average over time. These empirical results are further supported by data observations (see Appendix 5, 8 and 9) which show the share of manufacturing output and employment in the total economy declining at the national and regional level over time.

[172] Ideally a region wants to allocate its resources to sectors which are highly productive and have a large share as opposed to allocating resources to sectors which are less productive.

Table 52: North East shift share results for All Manufacturing

	Industry mix	Productivity differential	Allocative Component	Gap between national and regional productivities
	μ_i	π_i	α_i	Y_i
1991	1.07750	0.56231	-0.47746	1.16235
1993	0.75083	2.47624	-0.29468	2.93239
1995	1.15587	0.70429	-0.03651	1.82365
1996	1.07792	-1.94995	-0.24652	-1.11854
1997	0.83279	-0.90631	-0.17197	-0.24550
1998	0.53361	-1.60748	0.29280	-0.78106
1999	0.33015	-0.94714	0.29353	-0.32346
2000	0.36845	-1.78038	0.40509	-1.00683

Source: Author's calculations

The productivity differential component results for the manufacturing sub sectors (Table 52) show that the productivity differential component for the North East has been declining over time from being +0.56231 in 1991 to being -1.78038 in 2000. In the context of the manufacturing sub sectors of the North East's economy, these results suggest that over time the region has moved away from having productive manufacturing sectors in 1991 to having less productive manufacturing sectors in 2000 in comparison to the UK average suggesting that the relative productivity of sectors has fallen. This is further supported by the data observations presented in Table 46 (see Chapter five section 5.5) which showed the total manufacturing productivity level in the North East to be above the UK average in 1991 and below it in 2000.

The allocative component in Table 52 for manufacturing industry in the North East illustrates a move from a negative position in 1991 of -0.47764 to a positive position of 0.40509 in 2000 suggesting that the North East has become specialised relative to the UK average in sectors whose productivity is above the UK average, implying convergence. The allocative component for manufacturing industry as a whole also suggests that over time the region has become more efficient at allocating resources over the different manufacturing industrial sectors. This is further supported by the data observations presented in Table 46 (see Chapter five section 5.5) which showed three sectors[173] in particular to have below UK average labour productivity in 1991 but above average levels in 2000. In addition these same three sectors showed faster productivity growth relative to the UK average (see Table 36). The sectors *Wood & paper products* (20), *Chemical man-made fibres* (24) and *Transport equipment* (34-35) are important sectors in the North East economy.

The final column in Table 52 represented by the symbol Y_i shows the gap between the regional and national average productivity levels additively decomposed into the three components. The results in Table 52 indicate that the total aggregate regional productivity for the North East manufacturing sub sectors has moved from being above the UK average in 1991 to below the national average in 2000 which is supported by data observations which show the gap between the North East and the UK to be widening; leading to divergence (see Table 46). The results obtained with regards to the total economy are explored below.

6.2.2 North East Total Economy Shift Share Results

The industry mix component results for the total economy (Table 53) reveal that the region's sectoral composition is diverging from the national average over time. The industry mix of the North East total economy over time appears to be changing from a factor of, -0.54581 in 1991 to -0.88666 in 2000. These empirical results are further supported by data observations (see Appendix 5 and 9) which show the North

[173] Wood & paper products (20), Chemical man-made fibres (24) and Transport equipment (34-35).

East to have a large share of manufacturing output and employment in comparison to the national average. On the other hand the data show output and employment shares in service sectors 70-74 (*Real estate, renting and business activities*) in the North East to be well below the UK average (see Appendix 5 and 9 and Table 42).

Table 53: North East shift share results for Total Economy

	Industry mix	Productivity differential	Allocative Component	Gap between national and regional productivities
	μ_i	π_i	α_i	Y_i
1991	-0.54581	-1.80905	-0.03318	-2.38804
1993	-0.56363	-2.12943	0.03617	-2.65688
1995	-0.68116	-1.24565	-0.09017	-2.01698
1996	-0.60661	-1.33997	-0.05457	-2.00115
1997	-0.75841	-2.18056	-0.09043	-3.02940
1998	-0.88309	-2.43776	-0.01765	-3.33850
1999	-1.14841	-2.00380	-0.24849	-3.40069
2000	-0.88666	-2.92597	-0.14168	-3.95431

Source: Author's calculations

The industry mix component imposes national productivity levels but allows sector weightings to differ. The movements of the industry mix component in Table 52 and Table 53 are both declining; showing the increasing importance of low productivity sectors. However there is a marked difference concerning the extent of the change for example manufacturing sectors show a decline but the values remain positive, in contrast to the total economy which also shows a decline but the values are negative. The results suggest that the sectoral productivity pattern of the manufacturing industrial structure of the North East is converging to that of the national average; this supported by data observations presented in Appendix 9 (which show the change in the share of output and employment by regional industry group). The data shows manufacturing as a whole to be declining at the national and regional level. On the contrary the results for the total economy suggest that the North East industrial structure is diverging from the national average which is also supported by data observations which show manufacturing output and employment shares in the North East to be above the UK average. On the other hand there is a difference between the North East and the UK average in sector 70-74 (*Real estate, renting and business activities*) whereby the North East shows below UK average output and employment shares (see Appendix 9 and Table 42).

The productivity differential component results for the North East's economy as a whole (Table 53) are similar to those of the manufacturing sub sectors (Table 52) showing that in 2000 the North East had less productive sectors in comparison to the UK average. The productivity differential component results for both the total economy and manufacturing show the widening gap in sectoral productivity for the North East overtime. However there is a distinct difference between the two sets of results in that the North East did have relatively high productive manufacturing sectors in comparison to the UK average in 1991, whereas the economy as a whole in 1991 already exhibited sectoral productivities below the UK average. At this point it would be important to note that there may be an aggregation problem at the sectoral level (sub sectors might show low productivity levels across the nation); hence it maybe an industry mix issue. In conclusion, based on the productivity differential shift share results, the North East has sectoral productivities below the national average in both instances and the movement appears to indicate that the gap in sectoral productiveness is widening, representing divergence. This evidence corresponds with the data observations presented in Table 52 and Table 53 (see Chapter five section 5.5) which both show the North East to have even less sectors with labour productivity above the UK average in 2000 than in 1991. In addition the labour productivity gap is much wider for the total economy than manufacturing.

The allocative component results for the total economy (Table 53) show a decline in the indicator over time from being a factor of -0.03318 in 1991, to -0.14168 in 2000; this suggests that the region in the economy as a whole over time has become even more specialised in low productive sectors relative to the UK average, implying divergence. As noted earlier the allocative component is also an indicator of the efficiency of each region in allocating its resources over the different industrial sectors. It measures the covariance between sectoral specialisation and productivity advantages. Based on this premise the allocative component results for manufacturing show that the North East region over time has become more efficient at allocating resources to manufacturing sectors over time; however the contrary is apparent for the total economy as a whole i.e. less productivity of services.

The gap between regional and national average productivity levels for the total economy (Table 53) as indicated by Y_i show that the total aggregate regional productivity for the North East is well below the national average in 2000. Upon comparison of the Y_i results for manufacturing sub sectors (Table 52) and the total economy (Table 53) there are stark differences between the two results. The value of the component for the manufacturing sector of the regional economy indicates the region has moved away from being above the UK average in 1991 to below it in the last five years of the study (1996-2000); this is further supported by the data observations presented in Table 46 and Table 48 (see Chapter five section 5.5). On the contrary the results for the regional economy as a whole depict a continued movement towards relative decline which is further supported by data observations presented in Table 48. These results show that the gap between national average productivity is widening over time, leading to divergence. In addition the results suggest that North East is characterised by employment in low productivity industries and sectors.

6.2.3 Cross Regional Manufacturing Shift Share results

The results in Table 54 (manufacturing) and Table 55 (total economy) show a snap shot of the productivity shift share results for the 12 regions of the UK in 2000. Refer to Appendix 13 for yearly regional shift share results for the period 1991-2000.

Table 54: Regional Manufacturing Shift Share Results 2000

	Industry mix	Productivity differential	Allocative Component	Gap between national and regional productivities
	μ_i	π_i	α_i	Y_i
NE	0.36845	-1.78038	0.40509	-1.00683
NW	0.36070	-1.86764	0.20650	-1.30043
Y&H	-1.10471	-2.57733	0.31542	-3.36662
EM	-2.00101	-2.35282	0.38163	-3.97220
WM	-1.78232	-4.21337	0.67172	-5.32396
E	0.74300	-0.90533	-0.28326	-0.44559
L	2.18631	6.00306	1.94327	10.13265
SE	2.16900	2.72616	-0.10821	4.78694
SW	0.23543	-0.23650	0.40963	0.40857
W	-0.21939	-0.04091	0.01184	-0.24847
S	0.51639	0.92582	0.14839	1.59060
NI	-2.07206	-3.86039	-0.45373	-6.38618

Source: Author's calculations

The cross regional industry mix component results in Table 54 show Northern Ireland to have the lowest value in comparison to its regional counterparts in 2000 (Appendix 8 shows the major difference in sector 17-18 (*textile & clothing*) in Northern Ireland to be well above the UK average with regards to output and employment shares[174]). This suggests that the region is specialised in the least productive manufacturing sectors compared to the South East and London which are specialised in the most productive manufacturing sectors. These

[174] In 2000 the output share of the *Textile and clothing* sector in Northern Ireland was 11.54% as opposed to the UK average being only 4.59%. The share of employment in this sector was 19.32% as opposed to the UK average 7.24%.

empirical results are further supported by data observations (see Table 46). In relation to the North East this suggests that other regions most notably Scotland, East of England, South East and London are more productive in manufacturing sectors.

Scotland, South East and London are the only regions which have sectoral productivity above the UK average as seen from the positive productivity differential component with regards to manufacturing sub sectors (Table 54). Furthermore these regions are increasing their share of manufacturing sub sectors at the UK level. On the other hand the West Midlands depicted the contrary; the lowest productivity differential component indicating a region which has the least productive manufacturing sub sectors in comparison to the UK average. Data observation presented in Table 46 support these findings.

When the allocative component is positive the region is specialised, relative to the UK average, in sectors whose productivity is above the UK average; the contrary when the allocative component is negative. Northern Ireland, East of England and the South East are the only three regions which have negative values suggesting, relative to the UK average, that these regions are specialised in low productive manufacturing sub sectors (Table 54). With regards to the remaining nine regions it appears that these regions are specialised relative to the UK in manufacturing sub sectors whose productivity is above the UK average. London attained the highest value which can be interpreted as the contribution to regional growth deriving from its specialisation in those manufacturing activities where London is most competitive.

The South West, Scotland, South East and London were the only four regions which exceeded the national average, as can been seen from the

Y_i positive values in Table 54. For the remaining eight regions, the total aggregate regional productivity is below the national average, as can be seen from the negative values suggesting that a significant gap exists as supported by data observations (see Table 46). In addition it is evident from Table 54 that those regions with below average productivities are characterised by employment in low productivity industries and regions. The section below will explore the productivity shift share results obtained for the total economy (Table 55).

6.2.4 Cross Regional Total Economy Shift Share results

Northern Ireland has the lowest Industry mix component of the twelve regions, with London having the highest (Table 55). Only four regions achieve a positive value; West Midlands, East of England, South East and London whereas the remaining regions have a negative value. Northern Ireland is specialised in the least productive sectors which makeup the total economy as compared to London being specialised in the most productive sectors.

The North East has the lowest productivity differential component in comparison to its other UK counterparts with the South East having the highest value. This suggests that the North East has sectoral productivity below the UK average and in comparison to its regional counterparts, suggesting that the productivity differential is not wholly explained by industry mix but instead a services sector issue. As noted earlier, the productivity differential component focuses on the contribution of sectoral productivity differences to the shift between regional and national average productivities on the assumption that the region's industry mix coincides with the national one. London, East of England and South East are the only regions which have sectoral productiveness above the UK average; this is supported by data observations (see Table 48) and reinforces the regional imbalance in the UK.

Table 55: Regional Total Economy Shift Share Results 2000

	Industry mix	Productivity differential	Allocative Component	Gap between national and regional productivities
	μ_i	π_i	α_i	Y_i
NE	-0.88666	-2.92597	-0.14168	-3.95431
NW	-0.40282	-2.43617	-0.16571	-3.00470
Y&H	-0.59462	-2.86513	0.14479	-3.31496
EM	-0.27800	-1.66170	-0.07976	-2.01946
WM	0.13366	-2.53711	-0.22839	-2.63185
E	0.28782	4.38060	-0.17507	4.49335
L	1.93654	1.97238	-1.03290	2.87602
SE	0.38076	3.34096	-0.08909	3.63262
SW	-0.97438	-0.58207	-0.07075	-1.62720
W	-1.25589	-1.18336	-0.12976	-2.56901
S	-0.61356	-1.84206	0.05436	-2.40126
NI	-1.99601	-0.62504	-0.77011	-3.39116

Source: Author's calculations

Scotland and Yorkshire & Humber are the only two regions which have positive allocative component values: hence these two regions are specialised relative to the UK average in sectors whose productivity is above the UK average (Table 55). The allocative component is also interpreted as an indicator of the efficiency of each region in allocating its resources over the different industrial sectors: hence the remaining ten regions which show negative allocative component value with London[175] depicting the lowest value are evidently regions which are inefficient at allocating their resources over the different industrial sectors.

London, East of England and the South West are the only regions which exceed national average productivity as seen from the result

[175] In terms of intra-regional differences there are sharp divisions of personal prosperity, with a concentration of areas of high unemployment and income and educational deprivation in inner London, particularly East London. In addition according to ONS (2000) London provides employment for 730,000 commuters drawn from across all regions of the UK, although predominantly from the South East.

which shows the gap between regional and national average productivities. However the remaining nine regions illustrate below national average productivity demonstrating a gap between national and regional productivity. This also shows that the remaining nine regions are characterised by employment in low productivity industries and sectors. The North East shows the lowest value in comparison to its regional counterparts.

Upon comparison of the regional shift share results for the total economy and the manufacturing sub sectors in 2000, the following emerges:-

- More regions show a negative value for the industry mix component in the total economy (8 regions) than for the manufacturing sub sectors (5 regions) suggesting the total economy differs more regionally.
- Northern Ireland has the lowest industry mix component for both the manufacturing sub sectors and the total economy
- London and the South East attain the highest productivity differential components.
- Ten regions show a negative value for the allocative component in the total economy as opposed to only three regions showing a negative value in the manufacturing sub sectors.
- London has the lowest allocative component for the total economy but the highest value for the manufacturing sub sectors which is explained by the large intra-regional disparity and the effect of inter-regional commuting on measured GVA (see Chapter five section 5.4)
- The North East shows the lowest total aggregate productivity value for the total economy suggesting that the North East is characterised by a specialism of low productivity industries and sectors.

- London and the South East are the only regions which show above UK average productivity for both manufacturing sub sectors and the total economy.

6.3 Covariance Shift Share Results

As discussed previously in chapter five section 5.7.2, as it stands the shift share method is not susceptible to statistical testing procedures, which means that there is no way of saying whether any of the measured components are statistically significant different from zero. It is possible, however to use analysis of variance to produce statistical estimates of the various components. This approach has been used by Weeden (1973) and Buck & Atkins (1983). In addition Fothergill and Gudgin (1979) provide a critical view of this approach as previously discussed in chapter five.

One way of measuring the role played by each shift share component in explaining inter-regional differences in output per worker is to compute the relative weight of the variance of each component in the overall observed variance as explained in chapter five section 5.7.2. This enables us to identify which factor makes the biggest contribution to the shift. Table 56 and Table 57 shows the volatility of the various shift share components of UK regions over time.

The industry mix variance in Table 56 has increased by 4.81% over time. The productivity differential component variance has also increased, by 69.38%. The overall productivity volatility between regions is explained by the productivity differential component and therefore the most important as seen from the Table 56 below. The rise in the variance of the productivity differential component shows that productivity gaps between sectors and regions are widening hence divergence is increasing over time irrespective of the industry mix.

Table 56: Share on Total Variance - Manufacturing Sub Sectors

MANUFACTURING SHIFT SHARE WEIGHTINGS									
	Industry mix		Productivity differential		Allocative component				Gap between national and regional productivities
	var (μ)	%	var(π)	%	var (α)	%	2Σcov	%	Yi
1991	2.02421	**17.49**	4.89044	**42.25**	0.27538	**2.38**	4.38513	**37.88**	11.5752
1993	2.56353	**15.53**	8.48814	**51.43**	0.21158	**1.28**	5.24143	**31.76**	16.5047
1995	2.59986	**14.26**	9.46768	**51.91**	0.19623	**1.08**	5.97338	**32.75**	18.2371
1996	1.97351	**11.13**	9.79674	**55.24**	0.35456	**2**	5.61122	**31.64**	17.736
1997	1.44966	**7.74**	11.7071	**62.48**	0.29641	**1.58**	5.28476	**28.2**	18.7379
1998	1.82622	**8.92**	12.0566	**58.86**	0.20057	**0.98**	6.39949	**31.24**	20.4829
1999	1.94841	**10.55**	9.95133	**53.9**	0.21957	**1.19**	6.34247	**34.35**	18.4618
2000	2.12156	**10.78**	8.28353	**42.11**	0.36891	**1.88**	8.89828	**45.23**	19.6723
% change 1991-2000	4.81%		69.38%		33.97%		102.92%		69.95%

Source: Author's calculations

When considering the weightings of the three shift share components in 2000 as represented by the percentages, it emerges that of the three variances the productivity differential variance accounts for 42.11% of the shift. In addition, prior to 2000 it was the productivity differential variance that accounted for a large proportion for the cause of the shift ranging from 42% in 1991 to 54% in 1999, as can be seen from Table 56. Hence, prior to 1999 the major cause of the shift was the productivity differential component. Furthermore the productivity differential component μ is the major influence on change, in comparison to the other components i.e. the industry mix and the allocative component have relative little impact on the relative productivity of manufacturing sectors. This also suggests that the rise of 69.38% in the productivity differential component during the period 1991-2000 indicates that the influence of the variance in productivity is growing in importance whereas the industry mix is becoming less important over time.

The covariance combination which measures the movement between the three components, as represented by $2\Sigma cov$ in the table accounts for a large proportion of the shift in 2000 approximately 45% which suggests that sectors are becoming more specialised in high and low productivity. In addition this combination covariance has over time been increasing in importance.

Table 57 below shows the share of variance of each of the shift share components in the overall observed variance for the whole economy, together with a term collecting the covariance in relation to the total economy. The industry mix component variance has shown a rise of 84.69% over time, whereas the productivity differential component shows a rise of 6.39%. The allocative variance component for the total economy shows a fall of 19.80% whereas the covariance component shows the highest rise of 106.04%.

Table 57: Share on Total Variance - Total Economy

TOTAL ECONOMY SHIFT SHARE WEIGHTINGS									
	Industry mix		Productivity differential		Allocative component				Gap between national and regional productivities
	var (μ)	%	var(π)	%	var (α)	%	$2\Sigma cov$	%	Yi
1991	0.52428	**8.52**	4.82888	**78.44**	0.14141	**2.3**	0.66195	**10.75**	6.15653
1993	0.73175	**9.41**	5.57080	**71.66**	0.05891	**0.76**	1.41211	**18.17**	7.77357
1995	0.60550	**9.51**	4.76742	**74.89**	0.07515	**1.18**	0.91766	**14.42**	6.36573
1996	0.71306	**11.52**	4.57576	**73.94**	0.06399	**1.03**	0.83589	**13.51**	6.18870
1997	0.76996	**11.6**	4.73515	**71.33**	0.05209	**0.78**	1.08148	**16.29**	6.63868
1998	0.98891	**12.68**	5.31718	**68.18**	0.04503	**0.58**	1.44810	**18.57**	7.79922
1999	0.87267	**10.78**	5.44356	**67.22**	0.03067	**0.38**	1.75069	**21.62**	8.09759
2000	0.96831	**12.77**	5.13587	**67.74**	0.11342	**1.5**	1.36390	**17.99**	7.58150
% change 1991-2000	84.69%		6.36%		**-19.80%**		106.04%		23.15%

Source: Author's calculations

When considering the weightings of the various variance components in 2000 the productivity differential component variance accounted for 67.74% of the shift, followed by the industry mix component variance accounting for 12.77% and finally the allocative component variance accounted for 1.50% of the shift. The covariance of all three components in 2000 attributed 17.99% to the shift. From Table 57 it emerges that most of the observed inter-regional variance in aggregate output per worker is attributable to the productivity differential component meaning productivity levels differ between regions and the gap is widening.

When comparing the weighting results for the total economy and the manufacturing sub sectors the industry mix component for the manufacturing sub sectors reports a rise of 4.81% (Table 56) whereas the total economy reports a rise of 84.69% over time (Table 57). Over time the productivity differential component increased by 6.36% for the total economy and by 69.38% for the manufacturing sub sectors, this high percentage change overtime is explained by the greater degree of heterogeneity exhibited by manufacturing. The allocative component over time has fallen by 19.80% for the total economy and increased by 33.97% for the manufacturing sub sectors. The gap between regional and national average productivities amongst the twelve regions for the manufacturing sub sectors shows a rise of 69.95% whereas the results for the total economy show a rise of 23.15% over time. This shows significant differences between manufacturing and the total economy. In both instances this suggests that the gap between national average productivity amongst regions is widening, contributing to divergence.

When considering the weightings of the three components in 2000 the productivity differential for the total economy emerges as accounting for the largest cause of the shift at 67.74%. The same is apparent for the manufacturing sub sectors where the productivity differential component accounts for 42.11%. Hence based on these results, inter-regional differences can be explained by region specific productivity differentials. The null hypotheses proposed earlier were as follows: *H2:*

The North East's industry mix does not explain the difference between national and regional output per worker.

H2a: Manufacturing sub sectors

H2b: Total Economy

With regards to the results obtained for the North East the tables below illustrate the percentage share of each component. Hence based on *H2a* the null hypothesis is accepted as the productivity differential component in 2000 accounts for 70% of the shift as can be seen from Table 58 below, as opposed to the industry mix accounting for only 14%.

Table 58: North East percentage share of shift share components (All Manufacturing)

%	μ_i	π_i	α_i
1991	51	27	23
1993	21	70	8
1995	61	37	2
1996	33	60	8
1997	44	47	9
1998	22	66	12
1999	21	60	19
2000	14	70	16

Source: Author's calculations

According to H2b the null hypothesis is accepted as can be seen from Table 59 below. The productivity differential component for the North East in 2000 accounted for 74% of the shift.

Table 59: North East percentage share of shift share components (Total Economy)

%	μ_i	π_i	α_i
1991	23	76	1
1993	21	78	1
1995	34	62	4
1996	30	67	3
1997	25	72	3
1998	26	73	1
1999	34	59	7
2000	22	74	4

Source: Author's calculations

When the proposed null hypothesis *H2* is extended to a UK regional perspective as opposed to just the North East the variance results for the UK regions for both manufacturing and the total economy with regards to the proposed null hypotheses (*H2a & H2b*) are again accepted. Thus industry mix does not explain the differences between national and regional output per worker across UK regions. The major finding reveals that the region specific productivity differentials accounts for virtually all inter-regional differences in output per worker. These regional specific productivity differentials are explained by the variation between UK regions in a number of factors (employment and the five productivity drivers, see Chapter three) that underlie regional economic differences. Chapter three revealed the persistent differentials in economic performance between UK regions in a number of factors (skills, investment, innovation, enterprise and competition) that underlie an economy's productivity. It is the differences in regional performance against each of these factors that will have an impact on regions' relative economic performance and help explain why certain regions are unable to fulfil their productive potential.

Conclusion

Chapter two identified the industrial mix of a region or country as an influence on growth, chapter three established the slow growth performance of the North East. Based on the fact that manufacturing is a prominent feature of the North East economy the role of manufacturing in economic development was discussed in chapter four. The purpose of this chapter was to establish whether the industrial mix of the North East was associated with its slow employment and productivity growth. This chapter commenced by discussing the results obtained from a conventional shift-share analysis and a modified version on employment and output per worker data. A shift share analysis has been used because it is fairly pragmatic and a relatively simple technique for analysing growth rates by regions and industry over a specific period. In conclusion two summary shift share results tables (Table 60 & Table 61) are discussed below. The shift share technique essentially uses three components to explain the disparity between regional and national growth.

- The national growth component measures the expected growth of employment and output per worker, if the region had grown at the national rate over the period

- The proportional shift represents the amount of change the region would have experienced had each of its industries grown at their national rates. Hence if a region has a predominance of industries which are growing faster than the national economy then the region will register a positive shift component.

- The differential shift is generally calculated as the residual. It reflects differences between a region's industrial growth rates and its national counterparts and is conventionally interpreted as that part of the regional growth performance which is attributable to regional specific factors and comparative advantages. In other words, it is that part of the region's growth that remains unexplained.

The shift share technique was firstly applied to employment data and then to output per worker. Upon comparison of the North East employment shift share results for the total economy and the manufacturing sub sectors in Table 60 below it first becomes apparent that employment in the economy as a whole has increased. Employment in the manufacturing sub sectors has declined nationally by 9.95% but has increased in the total economy by 17.81% implying that the decline in manufacturing employment has been displaced into other sectors of the total economy nationally.

Table 60: North East Employment Shift Share Results

	Region's employment growth	Growth due to other factors	Growth due to industry mix	National growth
	%	%	%	%
MSS	-15.50236	-5.55227	-1.09173	-9.95009
TE	7.05480	-10.76148	-1.45463	17.81628

Source: Table 50 & Table 51

In addition the North East reported the greatest manufacturing employment decline of 15.50% in relation to its UK counterparts which was almost double that of the UK average. Conversely the North East regional economy as a whole showed an increase in employment of 7% which was the smallest rise in comparison to its UK counterparts and approximately 10 percentage points below the UK average as seen in the bottom row in Table 60. The slow growth of an industry may be associated with the general economic environment which may be less amenable to growth in a region. General economic environment includes factors such as poor entrepreneurship, unsuitable labour reserves, high transport costs etc. However some parts of a region's slow growth maybe a direct result of an unfavourable industrial structure in other sectors of the regional economy.

For the North East the decline of manufacturing employment (15.50%) has been twice as fast compared to the increase in employment in the total economy (7.06%). Hence the rapid rate of decline in manufacturing has yet to be compensated in other sectors of the total economy which reinforces the high unemployment and low participation rates present in the North East as previously discussed in chapter three. At this point it is imperative to note that it sometimes takes time for labour markets to adapt to structural changes (see Chapter 4 section 4.9.2).

Structural changes are playing an important role in the ongoing employment stagnation. According a study by the Federal Reserve Bank of New York (Groshen & Potter, 2003) structural changes such as a permanent decline in demand; increasing international outsourcing of employment; technological change and production re-organisation are taking place in many industries. As the permanent lay-offs characteristic of periods of increasing structural change force the unemployed to find new jobs (often requiring new skills), longer average job search times and slower employment growth result. Workers in the country's manufacturing sector have been hit the hardest. These workers, whose jobs have been permanently eliminated, need assistance in the form of unemployment benefits, but also access to education and training programmes, so that they can acquire the education and skills needed to move into those industries experiencing job growth.

The negative North East residual component results for both manufacturing and the total economy suggest that the region suffers from specific regional factors. This is apparent as seen from chapter three where the North East was shown to be at the bottom or near the bottom of the league in relation to the two determinants of growth and the five drivers that underlie productivity. With regards to the manufacturing sub sectors and the total economy, the North East's residual component outweighs the structural component. This implies that despite the North East showing an unfavourable industry mix, it is the regional specific factors which are causing the slow employment growth (the residual component for the total economy is 10.45% and the industry mix component is 1.45%) i.e. industry output has grown more slowly.

Above, the shift share results in relation to employment were discussed, a modified version of the shift share technique (as discussed in section 6.2) was applied to enable an assessment of which part of regional and inter-regional differences in average productivity is attributable to the region-specific productivity differentials and which to the particular sectoral composition. In order to single out the role of these factors the shift share analysis was used to decompose regional output per worker differences with respect to the UK mean into three components: industry mix, productivity differential and allocative. Unlike the previous Table 60 where employment growth is considered, Table 61 below summarises the output per worker shift share results. When considering the share of the various shift share components for the North East the empirical results reveal that the productivity differential component (which represents the contribution of sectoral productivity differences to the shift between regional and national average productivities, on the assumption that the region's industry mix is the same as the national one) is the principal influence on the shift (as opposed to the allocative and industry mix component) for both manufacturing (69.71%) and the total economy (73.99%). However, despite the limited role played by the industry mix component it becomes apparent that a region's industry mix plays some role in explaining the economic problems of individual regions and localities. There is evidence that a region's initial sectoral composition does not predetermine its future growth path (Overman & Puga, 2002). A region's industry mix evolves over time, influenced by technological change, consumer preferences and the underlying resource base. Many regions are able either to develop or adapt their industrial composition to attract higher value added activities or to improve or adapt their productivity in those sectors.

The HMT *et al.,* (2001) report recognises that in order to close the productivity gap between more and less developed regions, development policies should tend to focus on providing the conditions in which regions and localities can successfully take advantage of new technological opportunities and structural change. Hence policies are focused on factors uniformly affecting the productivity of poorer regions, such as skill composition or competition policy which are primarily driven by endogenous growth theory (see Chapter two section 2.1.4); though the challenges may differ regionally. The results reveal regional specific differences are the principal factor; thus the approach the Government has taken is appropriate.

Table 61: Shift Share Output per worker Results

	Industry mix component	Productivity Differential Component	Allocative component	Total Regional Aggregate Productivity
	μ_i	π_i	α_i	Y_i
NORTH EAST				
Results for the North East (2000)				
MSS	0.36845	-1.78038	0.40509	-1.00683
TE	-0.88666	-2.92597	-0.14168	-3.95431
Percentage weightings for the North East (2000)				
MSS%	14.43	69.71	15.86	
TE%	22.42	73.99	3.58	
Change in Weightings Over time North East (1991-2000)				
MSS%	-65.81	-416.62	184.84	-186.62
TE%	-61.56	-61.83	-23.42	-60.39
UK REGIONS				
Variance Results for the UK regions(2000)				
MSS	0.96831	5.13587	0.11342	7.58150
TE	2.12156	8.28353	0.36891	19.67228
Percentage weightings Amongst 12 Regions (2000)**				
MSS%	10.78	42.11	1.88	
TE%	12.77	67.74	1.50	

*Negative percentage values represent a fall

** Note the weight of the co-variances are not presented in this table hence do not sum to 100

Source: Table 52 - Table 59

The weightings of the variance results amongst UK regions reveal that the productivity differential component is the principal influence on the shift, as opposed to the industry mix component and the allocative component[176] similar to the results for the North East. For the total economy the weighting of the productivity differential component is 67.74% and for the manufacturing sub sectors this component is 42.11%. These productivity differentials are likely to be caused by a number of factors, such as varying skills composition and innovation rates.

When considering the change of the variance weightings of the individual components over time, there is a distinct difference between the manufacturing sub sectors and the total economy. For the total economy, the variance of the industry mix component over time has increased by 84.69% as opposed to the manufacturing sub sectors component which reports a rise of 4.81%. On the other hand the variance of the productivity differential component for the manufacturing sub sectors shows a rise of 69.38% as opposed to the total economy reporting a rise of 6.39%. It therefore emerges that for the manufacturing sub sectors variance of the productivity differential component is rising at a faster rate, as opposed to the variance of the industry mix component which is rising at a faster rate for the total economy.

The variance gap between regional and national average of productivities, as recognised by the symbol Y_i, amongst the twelve regions for manufacturing shows a rise of 69.95% over time, whereas the total economy results show a rise of 23.15%. In both instances the gap between national average productivity amongst regions is widening, leading to divergence implying that the richer regions are

176 This component is viewed as measuring the covariance between sectoral specialisation and productivity advantages.

getting richer and poorer regions are getting poorer. Chapter three explored the persistent differentials in economic performance between UK regions in a number of factors (skills, investment, innovation, enterprise and competition). The differences in regional performance against each of these factors help explain why certain regions are unable to fulfil their productive potential.

The empirical results in this chapter reveal firstly that the North East's industry mix is not solely to blame for the region's poor economic performance. The results also reveal that regional and inter-regional differences can be explained by region-specific productivity differentials. Hence there are regional differences in labour productivity in the UK and these differences are attributable primarily to between-region differences in the labour productivity of given industries as opposed to between-region differences in the sectoral composition of the industrial economy. The evidence suggests that regions which lag behind suffer from uniform and widening productivity gaps, with very little role for the specific sectoral specialisation into activities with high or low output per worker.

Two reasons why the same sector would have a different performance between regions is that firstly the level of disaggregation of sectors, a more detailed composition could reveal a different story (see Chapter five section 5.7) and secondly, the economic and social circumstances of a regions differ, such as labour market, better skills matching than performance measures (see Chapter three).

Chapter 7: Statistical Analysis

Introduction

Chapter five introduced several hypotheses together with an in-depth critique and discussion of methods for testing such propositions. As previously noted in chapter four the empirical research is made up of two components. The first component considers the role of the industrial structure in explaining the slow labour productivity growth performance of the North East with regards to employment and output per worker as discussed in Chapter six.

The employment shift share results obtained in chapter six for the North East reveal that the region has an unfavourable industry mix. However based on the bigger residual component[177] values on the whole the industry mix does not critically constrain a regions growth potential. The shift share results for output per worker reveal that it is the region specific productivity differential that accounts for the gap between regional and national average productivities. As noted earlier in chapter five, the shift share technique is criticised on many grounds. Most notably it does not explain why individual industries grow faster in some regions than in others. Shift share provides no help in this direction. As Holden *et al.* (1989) have argued:

> *'The popularity of shift share is at least partly due to the fact that it appears to sidestep these tricky problems altogether. As such it does us a disservice. For a correct understanding of regional growth these problems must be successfully confronted'* (Holden *et al.*, 1989, p.33).

[177] Which is the part of the region's growth that remains unexplained and is interpreted as part of the region's growth performance which is attributable to regional specific factors.

In addition the shift share results are unable to provide a comprehensive explanation of why some regions grow quickly while others grow slowly. However the shift share technique allows the identification of the specific effect on the region's growth, enabling to at least eliminate one possible influence from the array of possible casual factors, providing a useful starting point in the analysis of regional growth differences. Based on the fact that the shift share technique is considered not to be capable of statistical validation, well established statistical methods are applied to provide a complementary view; this is the second component of the empirical research.

The second component of the empirical research can be further broken down into two sub groups. The first sub group uses non parametric tests: the Spearman Rank Correlation and Kendall Coefficient of Concordance. The second sub group of the empirical research aims to measure regional inequality, so as to assess whether differences in output per worker diminish (converge) or increase (diverge) over time, enabling us to measure whether productivity gaps are widening over time across the UK regions. Chapter five described the three popular measures of inequality:

1. Coefficient of variation; this is a measure of divergence of all observations of a series with respect to the mean. It applies ratios between two indicators which indicate the distance of each separate observation to the mean of the whole series. Regression and the *t*-test can then be applied.
2. Theil coefficient; like the coefficient of variation the Theil coefficient equally weights all observations in the distribution. The Theil coefficient is a decomposable coefficient which means that observations are grouped in mutually exclusive and completely exhaustive groups, hence total inequality measured by

the index can be decomposed into a between-group component and a within-group component.

3. Gini coefficient; is a one effect coefficient which uses weighted variables and also uses comparisons of spatial distribution.

This chapter will discuss the results obtained in relation to the non-parametric statistics and the three popular measures of inequality with regards to the proposed null hypotheses in chapter five; those being *H3* to *H9* which are all discussed below.

7.1 Spearman Rank Correlation

Output and employment data were used to calculate productivity levels which were then used to calculate the productivity (output per worker) growth rate. To reiterate, the annual average sector productivity growth rates for the each of the twelve UK regions as well as the UK were calculated for the time period 1991-2000 (see Chapter 4 section 4.9.1, Table 36 and Table 37).

Once the annual average productivity growth rates were calculated the significance of the relationship between regional and national productivity growth rates was considered using the Spearman Rank Correlation Coefficient. As noted in Chapter five section 5.8 the Spearman Rank Correlation coefficient is a non-parametric statistic which measures the ordinal association between two sets of variables which is based on rankings.

At this point it is important to note that industry groupings were further broken down into two, one which represented the total economy and the other which represented manufacturing sub sectors. The productivity growth rates over time of industries were ranked. In addition once the ranking had been performed the Spearman statistic which measures the correlation was calculated (see Chapter five section 5.8). A high positive correlation means that the ranking pattern is similar to the UK and the opposite when low.

Table 62 below reports the coefficient results derived from the Spearman rank correlation. Prior to discussing the results it is important to note that within the total economy there were a total of thirteen observations which refers to the number of industry groupings. On the same basis the total number of industry groupings within the manufacturing sub sectors was twelve.

Table 62: Spearman Rank Correlation Coefficient Results

Region	MSS	TE
(OBS)	*12*	*13*
NE	**0.18182**	0.74725*
NW	**0.40559**	**0.50549**
YH	0.73776*	0.72527*
EM	**0.56643**	0.73077*
WM	0.81119*	0.70879*
E	**0.24476**	0.73626*
L	**0.42657**	**0.11538**
SE	0.67133*	0.87363*
SW	**0.12587**	0.75824*
W	0.71329*	**0.37912**
S	**0.23776**	0.75275*
NI	**0.53497**	0.59890*

* Significant @ 5%

Source: Author's calculations

The second column in Table 62 shows the coefficient results, when considering the manufacturing sub sectors. Yorkshire & Humber, West Midlands South East and Wales have a high positive correlation with the national ranking ranging from 0.67 to 0.81[178]. This suggests that the

[178] The share of national output (Constant prices) represented by these regions in 2000 is as follows: Yorkshire and Humber, 8%; West Midlands, 11%; South East, 14%; and Wales represented 5%.

rankings of the productivity growth rate of sectors at the national level are similar to those at the regional level. The South West region has a large share of part-time workers which may explain why it has the lowest correlation coefficient of 0.12. The remaining regions which have a low coefficient indicate that sectors ranked at the national level are not similar to those ranked at the regional level.

The third column in Table 62 represents the coefficient results for the total economy. All the regions except the North West, London and Wales have an high positive correlation ranging from 0.59 to 0.87 which means sectors ranked at the national level are similar to those at the regional level. On the contrary, the North West, London and Wales have a low correlation coefficient ranging from 0.12 to 0.51. These results indicate that sectors ranked at the national level are not similar with those ranked at the regional level for these regions. These results show that productivity growth rates of sectors vary regionally in comparison to the UK average.

Furthermore Wales has a high correlation coefficient for the manufacturing sub sectors (0.71) but low correlation coefficient for the total economy (0.39) as did the East of England region. In the case of the South West, the contrary is apparent. There is a high positive correlation for the total economy (0.75) but a low correlation coefficient for the manufacturing sub sectors (0.13) and the same applies to the North East. A region may have a high positive correlation between sectors in the total economy and a low correlation coefficient in the manufacturing sub sectors and vice versa. In both instances a high positive correlation means that the change over time in a region's productivity growth rate is similar to that of the UK and the contrary when there is a weak correlation.

The Spearman Rank Correlation Coefficient is merely based on the ranking of industries productivity growth rates against the UK. It is also important to note that sector output weighting are not considered[179] (see Chapter four section 4.9.2). Like the Shift share techniques the Spearman Rank Correlation Coefficient test suffers from the aggregation effect. However in spite of these limitations it is an appropriate starting point in analysing the regional economy.

7.1.1 A test for significant Rank Correlation

The sample results can be used, like other statistical procedures to make an inference about the statistical significance of the correlation of ranks between the two variables. The null hypothesis to be tested was that the two sets of rankings are dependent, suggesting that the ranking will be the same, hence: - *H3: k sets of ranking are dependent*

H3a: Manufacturing sub sectors

H3b: Total Economy

Table 63 captures the critical values in relation to the degrees of freedom which, in this context, refers to the number of observations which were displayed in italics in Table 62.

Table 63: Critical values of the Spearman rank correlation coefficient

Degree of freedom	0.05
12	0.587
13	0.560

Source: Statistical Techniques in Geographical Analysis, Appendix IX

[179] It does not consider the share of national output these regions represent. In 2000 the share of output (Constant prices) represented by the 12 regions is as follows; North East (3%), North West (10%), South East (16%), South West (7%), Wales (4%), West Midlands (8%), East Midlands (6%), East of England (10%), Scotland (8%), London (18%), Northern Ireland (2%) and Yorkshire and Humber (7%).

In relation to the results obtained in Table 62, the critical value table above suggests the productivity coefficients for manufacturing sub sectors in Yorkshire & Humber, West Midlands, South East and Wales are significant at the 5% (95% confidence) level which illustrates that the results obtained demonstrate a ranking that is not just a random one. Conversely the regional correlation results in Table 63 the shaded areas most notably the North East, North West, East Midlands, East of England, London, South West, Scotland and Northern Ireland are not statistically significant.

The total economy correlation coefficient results suggest that the ranking for the North East, Yorkshire & Humber, East Midlands, West Midlands, East of England, South East, South West, Scotland and Northern Ireland, are significant according to the critical value table at the 5% level (95% confidence). On the other hand the results obtained for North West London, and Wales as depicted by the shaded area, may be random.

This section has considered the Spearman rank correlation coefficient which is a measure of association for two rank ordered sets of items. The hypotheses proposed were *H3: k sets of ranking are dependent*

> *H3a: Manufacturing sub sectors*
> *H3b: Total Economy*

In relation to critical values, the results in the shaded area show those regions where the null hypothesis is rejected and therefore conclude that the two sets of ranking are actually independent and not dependent. This translates as to meaning that the relative performance of sectors at the regional level is independent of that of the nation implying regional specific factors. These may include factors such as regional entrepreneurship, location, regional policy, unemployment, etc. like the regional specific factors discussed in relation to the shift share results. The proposed hypotheses *H3a* is rejected and accepted *H3b* with regards to the results obtained for the North East, however caution is advised with regards to the aggregation effect.

Chapter three set out the Government's policy for tackling the persistent differentials in economic performance across and within countries and regions of the United Kingdom, with emphasis on the North East. Chapter three also identified various factors that underlie regional economic differences between regions, the five productivity drivers. The North East's performance was assessed against each of these factors revealing that the region performs poorly relative to its regional counterparts.

The Spearman rank correlation is based on the ranking of productivity growth rates, therefore it is based on ordinal data and does not consider the actual rate of the growth nor does it capture regional specialisation. The total economy results for the North East are statistically significant revealing that the ranking is not random; hence when ranked, fast/slow growth sectors at the national level are similar to those ranked at the regional level. However the North East's manufacturing results are not statistically significant which can be explained by manufacturing specialisation.

7.2 Kendall coefficient of concordance W

As noted in Chapter five section 5.9 the Kendall coefficient of concordance W measures the degree of association amongst multiple rankings, unlike the Spearman rank correlation which considers the degree of association between only two sets of rankings. The null hypothesis to be tested is that K-sets of ranking are independent which can be translated as meaning that in the context of the league table of the productivity levels, regions do not sustain the same position and therefore move up or down the league table each year hence there is no regional sector specialisation. The proposition:- *H4: K sets of rankings are independent*

H4a: Manufacturing sub sectors

H4b: Total Economy

Here productivity levels are ranked and not productivity growth rates. In this context, the productivity levels of the 12 regions in a particular year and sector were ranked in ascending order; hence a region with the lowest productivity level was ranked 1 and a region with the highest productivity level was ranked 12.

Table 64[180] and Table 65 show the results obtained from the Kendall coefficient of concordance W. In both tables, the column headed *W* represents the Kendall coefficient and the column headed x^2 represents the test statistic. As with the Spearman Rank correlation the significance of any observed value can be tested by determining the probability associated with the occurrence under the null hypothesis of a value as large as x^2 with which it is associated. Furthermore the results are displayed in ascending order showing a weak correlation coefficient to a strong correlation.

[180] Tables 64 does not include sectors 5 (Fishing), 23 (Manufacture of Coke, Refined Petroleum and Nuclear Fuels) and 95 (Private Household with Employed Persons) due to regional suppression of data.

Table 64: Kendall coefficient of concordance W, Manufacturing sub sectors

Manufacturing Sub Sectors	Sector	Kendall Coefficient W	Test Statistic x
Leather	**19**	0.43859	38.59615*
Other Metals	**29**	0.44941	39.54808*
Rubber & plastic products	**25**	0.52863	46.51923*
Textile & clothing	**17-18**	0.58566	51.53846*
Non-metallic mineral products	**26**	0.58971	51.89423*
Basic metals	**27-28**	0.63844	56.18269*
Wood & wood products	**20**	0.63877	56.21154*
Transport equipment	**34-35**	0.66149	58.21154*
Electronic & optical	**30-33**	0.70520	62.05769*
Chemical & man-made fibres	**24**	0.79261	69.75000*
Other manufacturing	**36-37**	0.84725	74.55769*
Paper, printing & publishing	**21-22**	0.86582	76.19231*

* Significant @ 1%

Source: Author's calculations

When considering Table 64 the Kendall coefficient results for sectors are organised in ascending order showing that sector 19 (*Leather*) appears to have the weakest correlation coefficient with sector 21-22 (*Paper, printing & publishing*) having the strongest correlation coefficient. As the results are organised in ascending order, these results suggest that the performance of a region in terms of its productivity level ranking within a particular sector becomes more predictable the lower down the column you move (based on its ranking). Hence sectors with a low coefficient such as that of sector 29 (*Other* metals) suggests that the productivity level ranking of regions in this specific sector is more unpredictable, revealing that it is difficult to predict which region in a particular year will be most or least productive, hence no regional sector specialisation. Sector 29 (*Other* metals) for example in 1991 the North East was ranked 12, the most productive region, but in 1996 it was ranked 1 the least productive region and then in 2000 it was ranked 9 displaying an unpredictable movement. Conversely, sector 21-22 (*Paper, printing & publishing*) displays a strong correlation coefficient (0.92) which can be translated as meaning that regions sustain a certain position in terms of their productivity ranking over time. For example London was ranked 12 (12 representing the most productive region) every year (1991-2000), hence no variation in ranking over time showing sector specialisation.

Table 65: Kendall coefficient of concordance W, Total economy

Total Economy	Sector	Kendall Coefficient W	Test Statistic x
Electricity, gas and water supply	40-41	0.52316	46.03846*
Agriculture, hunting & forestry	01-02	0.61757	54.34615*
Hotels & restaurants	55	0.65625	57.75000*
Health & social work	85	0.77109	67.85577*
Education	80	0.78562	69.13462*
Real estate, renting and business activities	70-74	0.79830	70.25000*
Transport, storage and communications	60-64	0.80900	71.19231*
Financial intermediation	65-67	0.81163	71.42308*
Private households with employed persons	90-93	0.83195	73.21154*
Manufacturing	15-37	0.87150	76.69231*
Construction	45	0.89904	79.11538*
Wholesale & retail trade	50-52	0.89969	79.17308*
Public administration & defence	75	0.91532	80.54808*

* Significant @ 1%

Source: Author's calculations

Table 65 represents the sectors which make up the total economy; the table is organised in ascending order showing a range from a weak Kendall correlation coefficient as can be seen in sector 40-41 (0.52) to a strong coefficient, sector 75 (0.92). A majority of sectors in the total economy appear to have a high positive correlation ranging from 0.52 (*Electricity, gas and water supply*) to 0.92 (*Public administration & defence*) showing regional sector specialisation. These results suggest that the performance of a region in terms of its productivity level ranking within a particular sector becomes more predictable the lower down the column you move (based on its ranking). When considering the test statistic, yet again despite having a low W coefficient the x^2 is well above the listed critical value, listed in Table 66 showing all results (Table 64 & Table 65) to be highly significant.

Table 66: Critical values of Chi Square

Degree of Freedom	Probability under that $x^2 \geq$ chi square
11	0.001
	31.26

The null hypothesis that the k sets of rankings are independent can be tested by comparing the critical chi square value in the table above (Table 66). By this method, the distribution of x^2 under has been worked out and certain critical values have been tabled. If an observed x^2 is equal to or greater than that shown in Table 66, then the null hypothesis is rejected at that level of significance. Hence in relation to the proposed hypotheses:- *H4: K sets of rankings are independent*

H4a: Manufacturing sub sectors

H4b: Total Economy

The results obtained in Table 64 and Table 65 cause both null hypotheses (*H4a* & *H4b*) to be rejected as x^2 is greater than the critical value, which is 31.26 at the 0.001 level; that is, the rankings are not independent.

In conclusion, at the one percent level of significance, the positive correlation of the rankings of regional productivity levels over time is higher than it would be by chance as the x^2 test statistic exceeds the chi square critical value. Based on this information the null hypotheses (*H4a* & *H4b*) are rejected in both instances, therefore the productivity level rank position of a region in a particular sector tends to be fixed over time. That is to say regions with high/low productivity levels sustain the same high/low rank position over time, this also suggests regional specialisation in sectors. In the context of both the manufacturing sub sectors and the total economy the rank position of regions in relation to productivity levels tend to be static over time. These results reveal that the high/low productivity level trend path of regions over time is fixed making it difficult for regions to break out explained by exogeneity and cumulative causation.

In many parts of economics such as the new growth theory and endogenous growth models there is an assumption that a complex system of determinants will tend to lead to a state of equilibrium (see chapter two). However, when this tendency is absent, terms like virtuous circle and vicious circle (or virtuous cycle and vicious cycle) are used to describe this pattern of events. Both circles are complexes of events with no tendency towards equilibrium (at least in the short run). Both systems of events have feedback loops in which each iteration of the cycle reinforces the first (positive feedback). The difference between the two is that a virtuous cycle has favourable results and a vicious cycle has deleterious results. These cycles will continue in the direction of their momentum until an exogenous factor intervenes and stops the cycle. Hence regions such as the North East are trapped in a vicious circle[181] of low economic growth preventing the region from achieving a strongly improved growth path.

Endogenous growth theory as discussed in chapter two provides some insight which helps to explain regional growth differences. Endogenous growth economists believe that improvements in productivity can be linked to a faster pace of innovation and extra investment in human capital; they also stress the need for Government policies and private

[181] The self perpetuating nature of the growth process.

sector institutions and markets which nurture innovation, and provide incentives for individuals to be inventive. There is also a central role for knowledge as a determinant of economic growth. Endogenous growth theory[182] predicts positive externalities and spill-over effects from the development of a high valued-added knowledge economy which is able to develop and maintain a competitive advantage in growth industries in the global economy.

7.3 Coefficient of Variation

In isolation the coefficient of variation results are unable to provide any substantial information; it illustrates variation, but does not explain it. (See Appendix 14 for Regional Coefficient of Variation Results and Appendix 15 for Sector Coefficient of Variation Results). Hence once the coefficients of variation were computed a scatter graph was plotted to which a simple linear regression line was added to show the change over time, enabling us to deduce whether relative productivity levels amongst regions or sectors are converging or diverging over time. The scatter graphs to which the linear regression line was added are illustrated in Appendix 16 (regional) and Appendix 17 (sector). Two statistical tests are performed on the coefficient of variation results: the first being a regression line where the angle of the slope is considered; and the second being *t*-test enabling us to assess whether changes are statistically significant. The null hypotheses to be tested are as follows:

> *H5: Comparing regions, no variation in the dispersion of productivity levels amongst sectors over time.*
>
> > *H5a: Manufacturing sub sectors*
> >
> > *H5b: Total Economy*
>
> *H6: Comparing sectors, no variation in the dispersion of productivity levels amongst regions over time.*

[182] See Chapter two section 2.1.4

H6a: Manufacturing sub sectors

H6b: Total Economy

7.3.1 Regression

The null hypothesis to be investigated in this instance is that there is no variation in the dispersion of productivity levels over time hence no rise or fall in convergence. This section will discuss the coefficient which represents the angle of the slope and the *P*-value which is the probability of the estimate being statistically significant, as reported in Table 67 - Table 70. The coefficient shows convergence when negative and divergence when positive. In Table 67 - Table 70 the shaded coefficient values represent where convergence is taking place. The shaded *P*-values represent where the proposed null hypothesis is rejected at the 5% level.

Table 67: Regional Regression Results for MSS

	Coefficients	*P-value*
NE	-0.0021	0.8275
NW	-0.0047	0.5964
Y&H	-0.0115	0.1386
EM	-0.0051	0.2425
WM	-0.0050	0.0839
E	-0.0205	0.0034*
L	0.0024	0.6350
SE	-0.0163	0.0932
SW	-0.0060	0.1944
W	-0.0120	0.0661
S	-0.0046	0.4620
NI	0.0056	0.2066

* Critical value at 5% level

Source: Author's calculations

Table 67 represents the regional regression coefficient and probability value results for the manufacturing sub sectors. Only two regions of the UK, London and Northern Ireland report divergence amongst the manufacturing sub sectors based on the positive coefficient, as opposed to the remaining ten regions showing convergence as seen by the shaded coefficients. The East of England region reports the greatest convergence over time (-0.0205) with the North East region reporting the smallest amount (-0.0021). The probability value explains the chance of convergence or divergence taking place over time. For the East of England region the null hypothesis is rejected at the 5% level suggesting that variation in the dispersion of productivity levels over time is taking place (*H5a*) which can be in part be explained by the influence (spill-over effects) of London and the South East. In the other eleven instances the null hypothesis that there is no variation in the dispersion of productivity levels over time is accepted. Wales reports the lowest probability of 6% with the North East illustrating the highest probability of 83% that there is no variation in the dispersion of productivity levels taking place over time.

Prior to discussing Table 68 and Table 69, as noted earlier in the previous section, the total economy results are split into two categories. The first (where 13 is displayed in brackets) shows where the various manufacturing sub sectors are represented by one sector (total manufacturing). On the contrary, where the total economy results are displayed by a bracketed 24 this represents each individual manufacturing sub sector.

Table 68: Regional Regression Results for TE (13)

	Coefficients	*P-value*
NE	0.0154	0.2458
NW	0.0245	0.0136*
Y&H	0.0265	0.0004*
EM	0.0219	0.0516*
WM	0.0160	0.1631
E	0.0103	0.1353
L	0.0501	0.0061*
SE	0.0251	0.0015*
SW	0.0254	0.0006*
W	0.0188	0.1073
S	0.0394	0.0121*
NI	0.0160	0.0061*

* Critical value at 5% level

Source: Author's calculations

The positive coefficient results in Table 68 illustrate that dispersion of productivity levels within each of the twelve regional economies is diverging over time. The cause of divergence can be partly explained by the growth in the share of output and employment at the national level in the *Finance and Business Services* sector. The share of output of the *Finance and Business Services* sector grew by 5.24 percentage points between 1991 and 2000. The share of output of the *Finance and Business Services* sector in 2000 was 29.15% (see Table 33 and Table 34). When considering the extent of the divergence the East of England (0.0103) closely followed by the North East (0.0154) regions show the smallest change in the dispersion of productivity levels over time. The *Finance and Business Services* sector in the North East represented 21% of total regional output in 2000 well below the national average. On the contrary Scotland (0.0394) and London (0.0501) report the greatest change in the dispersion of productivity levels over time leading to divergence. The *Finance and Business Services* sector in London represented 42% of total regional output in 2000, a growth of 6.87 percentage points since 1999.

The shaded *P*-value shows where the null hypothesis (*H5b*) is rejected - that is, there is no variation in the dispersion of productivity levels over time. The null hypothesis is rejected in eight of the twelve regions at the 5% level of significance, where the range of probability varies from virtually zero in Yorkshire & Humber to 5.16% in the East Midlands as represented by the shaded area. This again can be explained by the relative importance of the service sector. In the case of Wales, the East of England, West Midlands and the North East the probability ranges from 11% in Wales to 25% in the North East; hence the null hypothesis (*H5b)* is accepted, that there is no change in the dispersion of productivity levels over time, as the probability is more than 95%.

Table 69: Regional Regression Results for TE (24)

	Coefficients	*P-value*
NE	0.0097	0.1474
NW	0.0149	0.0162*
Y&H	0.0167	0.0023*
EM	0.0136	0.0699
WM	0.0113	0.2538
E	-0.0009	0.8610
L	0.0342	0.0082*
SE	0.0085	0.1535
SW	0.0160	0.0058*
W	0.0072	0.3390
S	0.0264	0.0253*
NI	0.0144	0.0050*

* Critical value at 5%

Source: Author's calculations

Table 69 shows the results for the twelve UK regional economies where the total economy encompasses each of the individual manufacturing sub sectors unlike Table 68 where the sum of the individual manufacturing sub sectors, was considered. The East of England is the only region which shows convergence based on the negative coefficient value (the significance is opposite of Table 68). The remaining eleven regions show divergence of the dispersion of productivity levels over time, which range from 0.0072 (Wales) to 0.0342 (London). The cause of this divergence can be explained by the growth in the share of output and employment in *Finance and Business Services* sector (see Table 33 and Table 34) as well as the fast labour productivity growth rate.

The shaded *P*-values illustrate those regions where the null hypothesis (*H5b*) is rejected at the 5% level of significance. Of the twelve regions the hypothesis (*H5b*) is rejected, that there is no variation in the dispersion of productivity levels over time in six regions where the probability ranges from 0.23% (Yorkshire & Humber) to 2.53% (Scotland). However in the remaining six regions the null hypothesis (*H5b*) is accepted, that there is no variation in the dispersion of productivity levels over time; the probability ranges from 7% in the East Midlands to 86% in the East region. Table 70 below reports on the results obtained for the individual sectors of the economy.

Table 70: Sector Regression Results

		Coefficients	*P-value*
01-02	Agriculture, hunting & forestry	0.0206	0.0017*
17-18	Textile & clothing	0.0097	0.0195*
19	Leather	-0.0082	0.7230
20	Wood & wood products	-0.0144	0.0083*
21-22	Paper, printing & publishing	0.0028	0.0777
24	Chemical & man-made fibres	0.0005	0.8589
25	Rubber & plastic products	-0.0132	0.0001*
26	Non-metallic mineral products	0.0000	0.9959
27-28	Basic metals	-0.0116	0.0002*
29	Other metals	-0.0112	0.0622
30-33	Electronic & optical	-0.0031	0.5018
34-35	Transport equipment	-0.0073	0.1025
36-37	Other manufacturing	-0.0218	0.0003*
15-37	Total manufacturing	0.0022	0.0187*
40-41	Electricity, gas and water supply	0.0066	0.1257
45	Construction	-0.0103	0.0094*
50-52	Wholesale & retail trade	0.0003	0.7971
55	Hotels & restaurants	-0.0041	0.0156*
60-64	Transport, storage and communications	-0.0009	0.6409
65-67	Financial intermediation	-0.0035	0.2303
70-74	Real estate, renting and business activities	0.0008	0.3800
80	Education	-0.0036	0.1188
85	Health & social work	0.0018	0.0505*
90-93	Private households with employed persons	0.0024	0.6284
Total economy		0.0003	0.6993

* Critical value at 5%

Source: Author's calculations

Once again the shaded negative coefficient values illustrate convergence; of the twenty-four sectors, thirteen sectors illustrate convergence of the dispersion of productivity levels over time, ranging from -0.0218 (36-37) to -0.0009 (60-64). The remaining eleven sectors illustrate divergence based on the positive coefficient value.

The shaded *P*-value results illustrate where the null hypothesis (*H6*) is rejected, that there is no variation in the dispersion of productivity levels amongst regions over time; for ten sectors (excluding the total economy) the proposed hypothesis (*H6*) is rejected, on the grounds that the probability values are less than 5% ranging from virtually zero (25) to 5.05% (85). In the remaining fourteen sectors (excluding the total economy) the null hypothesis is accepted based on the premise that the probability is greater than 5%; the probabilities range from 6.22% (29) to 99.9% (26).

The total economy and total manufacturing both show divergence based on the positive coefficient results implying that the dispersion of productivity levels amongst regions is diverging over time; this is associated with differences in the growth of GVA. However there is a stark difference in the *P*-value results. For the total economy the proposed hypothesis *H6b* is accepted, that there is no variation in the dispersion of productivity levels amongst regions over time where the probability is 69.9%, the contrary is apparent with regards to total manufacturing hence *H6a* is rejected as the probability 1.87%. This in part can be explained by the varying degree of the relative importance of manufacturing at the regional level. For example the share of manufacturing output in the North East in 2000 was 21.43% as opposed, 8.75% for London. The share of manufacturing employment in the North East was 15.91% as opposed to 6.22% for London for the same period. At the national level the share of manufacturing output in 2000 stood at 15.86% with employment at 13.32% (see Appendix 8 & 9 for share of output and employment at the regional level).

7.3.2 *t*-Test

As pointed out earlier the coefficient of variation is only able to provide us with a time series trend line, which may move up and down or remain constant. Therefore in order to understand whether changes are statistically significant (i.e. representative) a single sample *t*-Test is computed. A single sample *t*-Test will enable us to assess whether the coefficient of variation results are from a different population. *t* is a measure of the difference between the means of two sets of data or, in a single sample, it is the extent to which the actual mean differs from the expected mean.

In order to understand whether the coefficient of variation results are statistically significant a single sample t-test is performed in order to show whether or not the sample is drawn at random from a population with a well known mean. See Appendix 18 for the results obtained; in all instances the *t*-test results obtained are not statistically significant at the 5% level of significance (i.e. probability results have occurred by chance) suggests that there is a series of unique factors (regional specific and industry specific factors) in each region / sector; hence no one solution to a region's or a sector's problems is indicated. Chapter three showed significant and persistent differences in economic performance between UK regions. In addition a number of key factors were identified which underlie these regional differentials such as the differences between regions in the provision of skills, investment, innovation, enterprise and competition. In particular against the above mentioned key factors the North East's was characterised as a region which was near or at the bottom of the league, performing poorly compared both to the national average, and relative to its regional counterparts (see Chapter three).

7.4 Theil Coefficient

The Theil Coefficient is a standard inequality measure which, in the context of this thesis, has been employed to examine the inter-regional inequality in output per worker. The measure is frequently used to analyse the extent to which total inequality can be attributed to differences *between* and *within* groups. Hence it was first applied to regions (see Chapter 5 section 5.12 for the illustration of *g* when applied to a region) and then to sectors. When *g* is a region, we want to know about total inequality in productivity levels as broken down into between and within region effects. Two separate formulae are used to compute inequality *between* and *within* regions, where *B* represents inequality attributed to *between* region differences and *Cg* represents inequality of productivity levels attributed to differences *within* regions (see Chapter five section 5.12 for the formula). Both formulae are then applied to sectors (see Appendix 19 for a specimen illustration of the calculations). The results obtained for regions and sectors are then used to explain the cause of such inequalities

Hence:

- **Regions** – Total inter-regional inequality in the productivity levels amongst regions – the cause of that inequality being productivity variation by sector.
- **Sectors** - Total inter-regional inequality in productivity in sectors - the cause of that inequality being productivity variation by region.

7.4.1 G is a region

The hypotheses to be tested in this section of the chapter are as follows:

H7: No variation of inequality within and between regions over time

H7a: Manufacturing sub sectors

H7b: Total Economy

Table 71 shows total inter-regional inequality in output per worker between and within regions in the manufacturing sub sectors. The table firstly shows that inequality within regions contributes more to total inequality than does inequality between regions. However inter-regional inequality between regions is increasing over time, from a share of 9.02% in 1991 to 20.02% in 2000 whereas inequality within regions is declining in share over time from 90.98% in 1991 to 79.98% in 2000. Furthermore the vast majority of total inequality is accounted for by differences in productivity levels between sectors, within regions despite the decline. The contribution of inequality between regions is lower even though divergence is taking place. Total inter-regional inequality over time is however converging as seen from the Theil coefficient value of 0.036 in 1991 to 0.020 in 2000.

Table 71: Inequality within and between regions - Manufacturing

g = region	1991	1993	1995	1996	1997	1998	1999	2000
Inequality Within	0.0360	0.0488	0.0431	0.0480	0.0367	0.0324	0.0385	0.0205
IW%	90.98	93.45	90.86	92.54	88.26	86.25	88.99	79.98
Inequality Between	0.0036	0.0034	0.0043	0.0039	0.0049	0.0052	0.0048	0.0051
IB%	9.02	6.55	9.14	7.46	11.74	13.75	11.01	20.02
Total inequality	0.0360	0.0488	0.0431	0.0480	0.0367	0.0324	0.0385	0.0205

Source: Author's calculations

Table 72 below reports on the results obtained in relation to the total economy; it becomes apparent that total inter-regional inequality is increasing over time; the Theil coefficient moves from 0.11714 in 1991 to 0.1559 in 2000. The contribution of inequality within regions (differences in productivity levels between sectors in a region) plays a much more significant role than does the inequality between regions. The share of inter-regional inequality within regions is increasing over time from 97.67% in 1991 to 98.54% in 2000.

Table 72: Inequality within and between regions - Total economy

g = region	1991	1993	1995	1996	1997	1998	1999	2000
Inequality Within	0.1171	0.1264	0.1307	0.1622	0.1605	0.1869	0.1815	0.1559
IW%	97.67	97.67	97.56	98.41	98.14	98.90	98.74	98.54
Inequality Between	0.0028	0.0030	0.0033	0.0026	0.0031	0.0021	0.0023	0.0023
IB%	2.33	2.33	2.44	1.59	1.86	1.10	1.26	1.46
Total inequality	0.1199	0.1294	0.1340	0.1649	0.1635	0.1890	0.1838	0.1582

Source: Author's calculations

Table 72 shows that differences in productivity levels between sectors within regions are the major cause of total inter-regional inequality. The Theil coefficient shows total inequality in manufacturing sub sectors to be converging over time whereas the opposite is apparent for the total economy. The convergence of the manufacturing sub sectors is further supported by the data observations reported earlier in chapter four (section 4.4.1) which showed that in the UK the overall proportion of output and employment accounted for by manufacturing has fallen since 1970 (Figure 5). Table 33 and Table 34 presented in chapter three (section 3.9) also showed the decline in the share of manufacturing output and employment in the UK for the period 1991-2000. At the regional level this same pattern emerged (See Appendix 8 and 9). Divergence in the total economy is also supported by data observations presented in chapter three whereby non manufacturing industries such as the *Real estate, renting and business activities* sector is expanding at faster rates of productivity growth than other parts of the economy. However the share of output and employment of the service sector varies regionally.

7.4.2 G is a sector

The hypotheses to be tested in this section of the chapter are as follows:

H8: No variation of inequality within and between sectors over time.

H8a: Manufacturing sub sectors

H8b: Total Economy

Table 73 illustrates total inter-regional productivity inequality of sectors in relation to manufacturing sub sectors. The results in Table 73 reveal that the share of total inequality within sectors over time is converging as can be seen from being 27.90% in 1991 to 23.75% in 2000. The contrary is apparent for the results with regards to the share of total inequality between sectors from being 72.10% in 1991 to being 76.25% in 2000. However the extent of the inter-regional productivity inequality is mainly accounted for by inequality in productivity levels between sectors as opposed to within sectors. This significance can be interpreted as meaning that inequality between sectors accounts for a large percentage of total inequality in the context of manufacturing sub sectors. The total inequality Theil coefficient shows that the sectoral inequality of productivity levels is declining over time therefore the productivity level gap between and within the manufacturing sub sectors is narrowing and hence converging.

Table 73: Inequality within & between Sectors (Manufacturing)

g = sector	1991	1993	1995	1996	1997	1998	1999	2000
Inequality Within	**0.0122**	**0.0186**	**0.0101**	**0.0145**	**0.0134**	**0.0099**	**0.0134**	**0.0097**
IW%	27.90	31.67	20.25	26.77	31.01	25.17	30.55	23.75
Inequality Between	**0.0316**	**0.0402**	**0.0399**	**0.0397**	**0.0298**	**0.0293**	**0.0304**	**0.0312**
IB%	72.10	68.33	79.75	73.23	68.99	74.83	69.45	76.25
Total inequality	**0.0438**	**0.0588**	**0.0500**	**0.0543**	**0.0432**	**0.0391**	**0.0438**	**0.0409**

Source: Author's calculations

Table 74 shows total inter-regional inequality of productivity levels between and within sectors of the total economy. When considering Table 74 the results reveal that the share of inequality between sectors appear to be declining over time from 91.73% in 1991 to 90.76% in 2000. The contrary is apparent in relation to inequality within sectors over time, increasing from 8.27% in 1991 to 9.24% in 2000. In addition it is evident from the results that inequality between sectors contributes more to total inter-regional inequality than does inequality within sectors. Total inequality of sectors is increasing over time which suggests that the gap is widening and hence diverging.

Table 74: Inequality within & between Sectors (Total Economy)

g = sector	1991	1993	1995	1996	1997	1998	1999	2000
Inequality Within	0.0112	0.0116	0.0111	0.0139	0.0153	0.0192	0.0225	0.0164
IW%	8.27	7.76	7.14	7.50	8.40	9.14	10.59	9.24
Inequality Between	0.1243	0.1375	0.1440	0.1717	0.1670	0.1909	0.1903	0.1615
IB%	91.73	92.24	92.86	92.50	91.60	90.86	89.41	90.76
Total inequality	0.1356	0.1491	0.1551	0.1856	0.1823	0.2101	0.2129	0.1780

Source: Author's calculations

When comparing and contrasting the evidence from Table 73 and Table 74, it becomes apparent that inequality between sectors contributes significantly more to total inequality than does inequality within sectors. Data observations of sectoral productivity growth rates reveal that sector productivity growth rates vary considerably; for example at the national level the *electricity gas and water supply sector* experienced the fastest (4.21%) productivity growth rate as opposed to the *agriculture, hunting and forestry* sector which experienced a decline (-1.06%) as seen in Table 37. More interestingly, the results over time for total inequality of the manufacturing sub sectors demonstrate convergence (0.04383 in 1991 and 0.04094 in 2000 -) as opposed to the results obtained for the total economy which shows divergence (0.13556 in 1991 and 0.17797 in 2000). As the manufacturing sectors are converging over time and the contrary it emerges from the results that the non-manufacturing sectors of the economy are the principal contributors to the divergence in output per worker.

The convergence over time of productivity levels in the manufacturing sub sectors is explained by the national and regional decline in manufacturing output and employment shares (see Appendix 5 for share of output and employment at the national level and Appendix 8 for those at the regional level). Conversely the divergence in the total economy is explained by the growth in the share of output and employment of non manufacturing sectors such as the *Real estate, renting and business activities* sector. However the output and employment share of the service sector varies regionally, which explains the widening of the productivity gap and implies transitional and adaptable problems as a consequence of globalisation.

In summary based on the Theil coefficient results in both instances, that is the total economy and the manufacturing sub sectors, the greater part of total inequality (when *g* is a region) is explained by inequality **within** (differences in productivity levels between sectors) regions and, in tern that inequality (when *g* is a sector) is explained by inequality **between** sectors; hence the proposed hypotheses *H7* & *H8* (*a* & *b*) are rejected.

7.5 Gini coefficient

The Gini coefficient was developed by an Italian statistician, Corrado Gini in the early 1900s. The Gini coefficient is one of the most commonly used measures of inequality. The coefficient varies between 0, which reflects complete equality and 1, which indicates complete inequality (one person has all the income or consumption, all others have none). The hypotheses to be tested by the Gini Coefficient are: *H9: Perfect equality in productivity levels amongst the North East's sectors.*

H9a: Manufacturing sub sectors
H9b: Total Economy

Table 75 below shows the results obtained under this method which have yielded measures of inequality that are persistently at a very low level implying almost perfect equality. This method does not add significantly to the narrative delivered by the other measures of inequality which show increasing inequality (i.e. coefficient of variation).

Table 75: Gini Results for Manufacturing Sub sectors & Total economy

	GINI MSS	GINI TE
1991	0.38864	0.38859
1993	0.38036	0.37086
1995	0.36751	0.39283
1996	0.35260	0.42299
1997	0.34029	0.38719
1998	0.34732	0.36906
1999	0.36104	0.37347
2000	0.35841	0.34485

Source: Author's calculations

Conclusion

In section 7.1 of this chapter the Spearman rank correlation coefficient was introduced which measures the association of two rank-ordered sets of items. In the context of this thesis the annual average productivity growth rate (output per worker) of the various sectors over time was ranked with the UK and various regions of the UK. The results for the North East's total economy yielded a strong significant positive correlation coefficient implying that the ranking of productivity growth rates of sectors at the national level coincided with those at the regional level. Conversely the results for manufacturing sub sectors yielded a low correlation coefficient which when compared with the critical value suggested that it may be random implying that there is no systematic ranking relationship which can be explained by the importance of manufacturing to the North East's economy. However the correlation maybe more important at a different level of disaggregation.

Section 7.2 introduced the Kendall coefficient of concordance to establish, whether the productivity level rank position of a region in a particular sector is fixed over time. That is to say regions with high/low productivity levels sustain the same high/low rank position over time. Based on the test statistic the null hypotheses in both instances (total economy and manufacturing sub sectors) was rejected, revealing that the ranking of productivity levels of regions over time tend to be static. Hence from the perspective of sectoral productivity levels the regional economy of the North East finds itself trapped in a vicious circle of low productivity and low growth, thus failing to close the relative productivity gap with its UK regional counterparts. It is therefore unable to exploit opportunities which yield spill-overs that can generate virtuous circles of growth. Both non-parametric tests i.e. Spearman and Kendall are unable to tell us about causality or to provide policy recommendations.

It emerges from the parametric tests in Table 76 below that different measures give widely different results when applied to the same set of data, indeed two measures of disparity may even point in the opposite direction. The Gini coefficient result showed almost perfect equality (Table 75) whilst the coefficient of variation results for both the total economy and total manufacturing showed increasing inequality over time. Hence the justification for considering several statistical measures (Theil coefficient, Gini Coefficient and Coefficient of variation) as opposed to just one. In addition the evidence from the various results of tables proves that a priori selection of just one indicator may lead to erroneous as it did in the case of the Gini coefficient results. However we are able to derive one overall picture from the results in Table 76.

The *P*-value for the regional coefficient of variation results for the North East region, for both manufacturing sub sectors and the total economy, reveal that the proposed null hypotheses *H5a* and *H5b* are accepted and that there is no variation in the dispersion of productivity levels over time. The regression coefficients reveal that the gaps in the variation of the dispersion of productivity levels over time, for the manufacturing sub sectors, are narrowing thus leading to convergence. Where the total economy is concerned, the gaps are widening thus leading to divergence for the North East. This divergence can be partially explained by the small share relative to the UK average of the services industry.

The results obtained for the various sectors of the economy are varied. Of the twenty-four sectors, thirteen sectors showed convergence in the dispersion of productivity levels over time based on the coefficient of variation (see Table 70). With regards to the probability value, *H6* is rejected; hence there was no evidence of variation in dispersion of productivity levels over time in ten of the twenty-four sectors. The coefficient results for the total economy showed divergence as did the results for total manufacturing. The *P*-value results obtained for total manufacturing meant that the null hypothesis *H6a* is rejected and divergence is confirmed.

The *t*-test results obtained with regards to *H5* and *H6* are not statistically significant at the 0.005 level. This suggests that there are a series of unique regional and industry specific factors present within each region and sector implying that each region and sector faces differing challenges. This would indicate that there is no one solution to tackle the challenges facing individual regions and sectors.

The Theil coefficient of variation results consider total inequality broken down into a within and between group. In both instances the greater part of total inequality amongst the UK regions is attributed to within regions and the cause of that inequality is between UK sectors. However there is a stark difference in the results obtained for the manufacturing sub sectors and the total economy. For the manufacturing sub sectors total inequality amongst UK regions and sectors is declining over time indicating convergence. Conversely, the results for the total economy indicate the opposite, showing that the productivity gap is widening over time leading to divergence. Hence the total inter-regional inequality gap for manufacturing sub sectors productivity is converging over time but the gap for the total economy is widening over time. The results obtained from the Gini Coefficient have proved to be inconclusive as they suggest almost perfect inequality.

Table 76: Summary tables of measures and statistics

Index/Indicator	1991	1993	1995	1996	1997	1998	1999	2000
Manufacturing Sub sectors								
Theil Decomposition (Regions)	0.03957	0.05223	0.04738	0.05186	0.04152	0.03755	0.04328	0.02569
Between Regions	0.00357	0.00342	0.00433	0.00387	0.00488	0.00516	0.00477	0.00514
Within Region	0.03600	0.04881	0.04305	0.04799	0.03665	0.03239	0.03852	0.02054
Between as % of Total	9.02	6.55	9.14	7.46	11.74	13.75	11.01	20.02
Within as % of Total	90.98	93.45	90.86	92.54	88.26	86.25	88.99	79.98
Theil Decomposition (Sectors)	0.04383	0.0588	0.05004	0.05426	0.04315	0.03912	0.04375	0.04094
Between Sectors	0.0316	0.04018	0.03991	0.03973	0.02977	0.02927	0.03038	0.03121
Within Sectors	0.01223	0.01862	0.01013	0.01452	0.01338	0.00985	0.01336	0.00972
Between as % of Total	72.10	68.33	79.75	73.23	68.99	74.83	69.45	76.25
Within as % of Total	27.90	31.67	20.25	26.77	31.01	25.17	30.55	23.75
Coefficient of Variation	0.12149	0.12996	0.12527	0.12584	0.12569	0.14175	0.14039	0.14094
Gini Coefficient (NE)	0.03949	0.06932	0.07484	0.04970	0.04511	0.06481	0.05940	0.05643
Total Economy								
Theil Decomposition Regions	0.11994	0.12938	0.13397	0.16486	0.16353	0.18898	0.18378	0.1582
Between Regions	0.0028	0.00302	0.00327	0.00262	0.00305	0.00208	0.00231	0.0023
Within Region	0.11714	0.12637	0.13071	0.16224	0.16048	0.1869	0.18146	0.1559
Between as % of Total	2.33	2.33	2.44	1.59	1.86	1.10	1.26	1.46
Within as % of Total	97.67	97.67	97.56	98.41	98.14	98.90	98.74	98.54
Theil Decomposition Sectors	0.13556	0.1491	0.15507	0.18559	0.18226	0.21006	0.21286	0.17797
Between Sectors	0.12434	0.13754	0.144	0.17168	0.16696	0.19087	0.19033	0.16153
Within Sectors	0.01122	0.01156	0.01107	0.01392	0.0153	0.0192	0.02254	0.01644
Between as % of Total	91.73	92.24	92.86	92.50	91.60	90.86	89.41	90.76
Within as % of Total	8.27	7.76	7.14	7.50	8.40	9.14	10.59	9.24
Coefficient of Variation	0.09592	0.10190	0.08809	0.08645	0.08959	0.09941	0.10180	0.09923
Gini Coefficient (NE)	0.03968	0.05478	0.05060	0.04437	0.05010	0.05164	0.05983	0.05091

Source: Author's calculations

Chapter 8: Conclusion and Policy Implications

Introduction

This chapter will conclude this thesis and provide some policy prescriptions in the light of the empirical evidence. The empirical results obtained in chapter six and seven are summarised, followed by a discussion of the study limitations. Thereafter policy recommendations will be drawn based on this empirical evidence.

8.1 Empirical results

Chapter three established the slow productivity growth performance of the North East which is predominantly a manufacturing intensive region. This thesis therefore examined whether the North East's slow growth performance was attributable to its industry mix; hence whether the industrial composition of the North East was constraining its future growth performance. In chapter three the inter-relationship between employment and productivity was discussed; to this effect the role of the industry mix in relation to employment (*H1*) and output per worker (productivity) (*H2*) was explored.

Prior to the discussion of the findings with regards to the tested hypotheses it is important to distinguish between the two proposed sub hypotheses. The sub hypotheses were split into two distinct categories; the first category represents *(sub hypothesis a)-manufacturing sub sectors)* which is based on subsection level data; the second category represents the sectors which make the total economy *(sub hypothesis b)-total economy)* and therefore includes manufacturing and is based on section level data.

Hence the hypotheses are subject to the aggregation effect (see chapter five section 5.3.3).

H1: The North East's industry mix does not explain the difference between national and regional employment change.

H1a: Manufacturing sub sectors – Nationally manufacturing has seen an employment decline of (9.95%), the North East results revealed the highest relative regional decline in employment (15.50%) for the period 1991-2000. The Residual component incorporates all factors not related to the activity structure and that are region specific, for example lack of entrepreneurship. The negative residual component for the North East was the highest in relation to its regional counterparts; this is interpreted as that part of the region's growth performance that remains unexplained. In addition the residual component (-5.55%) was larger relative to the industry mix component (-1.09%). Hence differences in mix are not significant.

H1b: Total Economy - Nationally the economy as a whole experienced employment growth of 17.82%, while the North East showed employment growth of only 7.05%, the smallest employment growth relative to its UK regional counterparts. The residual component yet again was the highest in relation to its regional counterparts as well as being larger (-10.76%) than the industry mix component (-1.45%).

H1a & *H1b* results revealed a negative industry mix component. From these results it becomes apparent that the industry mix plays some role in explaining individual region's economic performance. However it does not critically constrain the region's growth potential as seen by the larger value of the residual component relative to the industry mix component. A region's industry mix evolves over time as a consequence of the global impact, governed by technological change, consumer preferences and the underlying resource base. However in both instances the residual component out weighed the industry mix component; the residual component for the total economy was -10.76% and -5.55% for the manufacturing sub sectors. An explanation of high weightings of the residual component closely ties in with the poor performance of the North East in relation to the two determinants of growth as demonstrated in Chapter three and the five factors which underlie productivity. In particular the North East has high unemployment, low participation rates, low start-ups, lacks entrepreneurial spirit and is also a low skills economy across all sectors.

In addition there are distinct differences between the results obtained for the total economy and manufacturing. Manufacturing reports a decline in employment and the total economy shows a rise in employment. The decline in employment in manufacturing can be partly explained as a consequence of globalisation and offshore outsourcing and productivity improvements. The rise in employment in the total economy can be partly explained by a rise in employment in other sectors of the economy such as services and those displaced from manufacturing. When comparing the results it becomes apparent that there is a distinct change in the pattern of employment, shifting from manufacturing into other sectors of the economy.

H2: The North East's industry mix does not explain the difference between national and regional output per worker.

H2a: Manufacturing sub sectors – This hypothesis is accepted as the regional-national productivity differential component accounted for 70% of the shift in 2000 (see Table 59). The productivity differential component focuses on the contribution of regional productivity to the shift between national average productivity when the national industry mix is imposed.

H2b: Total Economy - This proposed hypothesis is accepted as the regional-national productivity differential component accounted for 74% of the shift (see Table 59).

In both cases *H2a* and *H2b* were accepted as the results obtained revealed that the industry mix does not explain the difference between national and regional output per worker but that in fact the productivity differential component is the principal factor associated with the differences. The productivity differential component for manufacturing over time shows a positive position in 1991 (0.56231) to a movement of a negative position (-1.78038) in 2000 (see Table 52). This movement is further supported by data observations presented in chapter five which showed manufacturing in the North East to be above the UK average in 1991 and below it in 2000 (see Table 46); hence the manufacturing productivity gap has been widening over time leading to divergence. The movement of the productivity differential component for the total economy (see Table 53) over time shows a negative position in both 1991 (-1.80905) and 2000 (-2.92597) which is also supported by data observations presented in chapter five (see Table 48); showing the productivity gap to be widening over time, leading to divergence. The data observations presented in chapter five (see Table 46 & Table 48) showed the productivity gap to be larger for the total economy as opposed to manufacturing; this coincides with the productivity differential component results.

H2 was extended to examine inter-regional inequality in output per worker for the 12 regions of the UK; the major finding of the results obtained revealed that the industry mix does not explain the differences between national and regional output per worker. The result obtained indicated that these differences can be attributed to region specific productivity differentials which are responsible for virtually all inter-regional differences in output per worker.

H3: K sets of ranking are dependent

The aim of testing these hypotheses was to examine whether change in the national industrial structure (the ranking of sectoral productivity growth rates over time) is similar at the regional level. Hence, to explore whether the ranking of national and regional productivity growth rates are dependent.

H3a: Manufacturing sub sectors - The results obtained for the North East yielded a weak correlation coefficient which meant that the relative productivity growth performance of sectors at the regional level were independent to the nation based on the rankings which implied that regional specific factors are important; hence *H3a* was rejected.

H3b: Total Economy – The results obtained for the North East regional economy as a whole yielded a high positive correlation coefficient which meant that the relative productivity growth performance of sectors at the regional level followed the same pattern at the national level based on the rankings, implying dependence; hence *H3b* was accepted.

There is a distinct difference between the results yielded for manufacturing and the total economy which in part can be explained by the aggregation effect. It is important to beware that one of the key limitations of using the Spearman rank correlation coefficient technique is that it is merely based on ranking and not actual productivity growth rates i.e. no indication of the distance; rankings can remain the same but growth rates can differ. Therefore it is unable to explicitly explain the causes of why in the North East manufacturing sub sectors do not follow the same pattern of productivity growth relative to the UK. However chapter three provides some insight in relation to the two determinants of growth and the five drivers of productivity with regards to the economic profile of the North East.

H4: K sets of rankings are independent

The purpose of testing these hypotheses was to assess whether the productivity level rank position of a region in a particular sector is fixed over time. That is to say do regions with high/low productivity levels sustain the same high/low rank position over time; hence K sets of ranking are independent.

H4a: Manufacturing sub sectors – See below

H4b: Total Economy - In both instances the proposed hypotheses are rejected on the basis that relative sectoral productivity level rankings of regions over time are static. This implies that the high/low productivity level trend path of regions is fixed. It is important to note that rankings can remain the same while productivity levels can differ.

H5: Comparing regions, there is no variation in the dispersion of productivity levels over time

The coefficient of variation is a measure of convergence of all observations (output per worker) of a series (regions and sectors) with respect to the mean. It applies ratios between two indicators which indicate the distance of each separate observation to the mean of the whole series. However the coefficient of variation is only able to provide a time series trend line, which may move up and down or remain constant. Chapter five section 5.11 pointed out that calculating coefficient of variation is not sufficient; hence the coefficient of variation results are supplemented by regression analysis and a single sample *t*-test with regards to *H5* and *H6*.

H5a: Manufacturing sub sectors – With regards to the *P*-value which is the probability of the estimate being statistically significant the null hypothesis for the Eastern region is rejected; however for the remaining eleven regions *H5a* is accepted implying that there is no convergence or divergence; therefore manufacturing sub sectors grow at the same rate.

H5b: Total Economy - With regards to the *P*-value results yielded for the total economy this null hypothesis is rejected for eight regions; therefore growth is not at the same rate. For the remaining 4 regions (North East, West Midlands, East and Wales) *H5b* is accepted implying that there is no convergence or divergence.

H6: Comparing sectors, there is no variation in the dispersion of productivity levels over time

H6a: Manufacturing sub sectors - The *P*-value results for manufacturing as a whole was rejected implying there was variation in the dispersion of productivity levels which is explained by the different growth rates; it was also rejected for the manufacturing sub sectors *17-18, 20, 25, 27-28, 36-37*. The null hypotheses were not rejected with regards to the result obtained for sectors *19, 21+22, 24, 26, 29, 30-33, 34-35*.

H6b: Total Economy – Based on the *P*-value results for the total economy the hypothesis was accepted. For the sectors which makeup the total economy the hypothesis was rejected based on the *P*-value in sectors *01+02, 15-37, 45, 55, 85*. On the contrary the null hypotheses were not rejected with regards to the results obtained for sectors *40-41, 50-52, 60-64, 65-67, 70-74, 80* and *90-93*.

In order to understand whether the results ascertained by coefficient of variation were statistically significant a single sample *t*-test was applied so as to show that it was unlikely to have been drawn at random from a population with a well known mean. With regards to *H5* and *H6*, the *t*-test results allow the assessment of whether the coefficient of variation results are from a different population. The t-test results for the regions and sectors revealed that the results obtained were not statistically significant at the 5% level, implying that there are a series of unique region and industry specific factors affecting productivity; hence are from a separate population. Chapter three provides some insight into the types of region and industry specific factors affecting productivity such as the two determinants of growth and the five drivers of productivity. Therefore there is no one solution to a region's or a sector's problems.

H7: No variation of inequality within and between regions over time

The Theil coefficient is a decomposable coefficient which means that observations are grouped in mutually exclusive and completely exhaustive groups, hence total inequality measured by the index can be decomposed into a between-group component and a within-group component. It was applied firstly to regions (*H7*) and then to sectors (*H8*).

H7a: Manufacturing sub sectors – The total inequality Theil coefficient reveals, regional productivity levels in manufacturing sub sectors are converging over time i.e. inequality is reducing.

H7b: Total Economy - The total inequality Theil coefficient reveals regional productivity levels in the total economy are diverging over time i.e. inequality is increasing.

In both instances *H7a & H7b* are rejected, as the greatest part of the differences in total inequality of productivity levels is contributed by differences in productivity levels between sectors within a region.

H8: No variation of inequality within and between sectors over time.

H8a: Manufacturing sub sectors – The total inequality Theil coefficient reveals sectoral productivity levels are converging over time i.e. inequality is reducing.

H8b: Total Economy - The total inequality Theil coefficient reveals sectoral productivity levels are diverging over time i.e. inequality is increasing.

In both instances *H8a & H8b* are rejected, as the greatest part of the differences in total inequality is contributed to by between sector differences in productivity levels.

H7 and *H8* revealed, the inequality of productivity levels between sectors, within a region are greater than the inequality of productivity levels within a sector, between regions.

H9: Perfect equality in productivity levels amongst the North East's sectors.

The results obtained were inconclusive showing almost perfect equality, contradicting the results obtained for the previous proposed hypotheses and the data observations.

H9a: Manufacturing sub sectors

H9b: Total Economy

Table 77 below provides a concise summary of the hypotheses proposed and the empirical results.

Table 77: Results table

<table>
<tr><th>TECHNIQUE
& HYPOTHESES</th><th>H
Variable</th><th>Manufacturing sub sectors
Subsection level data)
Ha</th><th>Total economy
(Section level data)
Hb</th></tr>
<tr><td rowspan="2">Shift Share employment (NE)

H1: The North East's industry mix does not explain the difference between national and regional employment growth rates.</td><td rowspan="2">H1
Aggregate UK and NE employment Level</td><td colspan="2">The difference between national and regional employment growth is explained by the North East industry mix, however the residual component out weights the industry mix.</td></tr>
<tr><td>Accepted:- Residual component showed the greatest decline in employment relative to UK regional counterparts representing the widest the gap</td><td>Accepted:- Residual component showed the lowest increase in employment relative to UK regional counterparts representing the widest gap</td></tr>
<tr><td rowspan="2">Shift Share output per worker (NE)

H2: The North East's industry mix does not explain the difference between national and regional output per worker.</td><td rowspan="2">H2
UK & NE employment and productivity levels</td><td colspan="2">The differences between national and regional output per worker is explained by the Productivity differential component for the North East</td></tr>
<tr><td>Accepted: Productivity differential component accounts for regional differences in output per worker.</td><td>Accepted: Productivity differential component accounts for regional differences in output per worker.</td></tr>
<tr><td rowspan="2">Shift Share output per worker (inter-regional)

H2: Inter-regional industry mix does not explain the difference between national and regional output per worker.</td><td rowspan="2">H2
UK & regional employment and productivity levels</td><td colspan="2">Inter-regional differences in output per worker are explained by the Productivity differential component.</td></tr>
<tr><td>Accepted: The region specific productivity differential accounts for virtually all inter-regional differences in output per worker.</td><td>Accepted: The region specific productivity differential accounts for virtually all inter-regional differences in output per worker.</td></tr>
<tr><td>Spearman Rank correlation

H3: k sets of ranking are dependent</td><td>H3
Productivity Growth Rates</td><td>Rejected - NE sectoral productivity growth rates are not associated with the national average implying regional specific factors.</td><td>Accepted - Regional sectoral growth performance pattern is similar to the national average</td></tr>
<tr><td>Kendall Coefficient of Concordance

H4: K sets of rankings are independent</td><td>H4
Productivity levels</td><td>Rejected - Regional ranking of productivity levels over time are static.</td><td>Rejected - Regional ranking of productivity level over time are static.</td></tr>
</table>

TECHNIQUE **& HYPOTHESES**		**H** **Variable**	**Manufacturing sub sectors** **(Subsection level data)** ***Ha***	**Total economy** **(Section level data)** ***Hb***
Coefficient of Variation (NE) *H5: Comparing regions, there is no variation in the dispersion of productivity levels over time*	Coefficient*	***H5*** Productivity levels	NE coefficient shows convergence	NE coefficient shows divergence
	P value		**Accepted**	**Accepted**
	T -test**		Regional specific factors	Regional specific factors
Coefficient of Variation (Sector) *H6: Comparing sectors, there is no variation in the dispersion of productivity levels over time*	Coefficient*	***H6*** Productivity levels	8 sectors showing convergence based on the coefficient – 19, 20, 25, 27-28, 29, 30-33, 34-35 & 36-37 4 sectors showing divergence based on the coefficient - 17-18, 21-22, 24 & 26 Total manufacturing showing divergence	5 sectors showing convergence based on the coefficient – 45, 55, 60-64, 65-67 & 80 7 sectors showing divergence based on the coefficient – 01-02, 15-37, 40-41, 50-52, 70-74, 85 & 93 Total economy showing divergence
	P value		**Rejected** in 7 sectors - 19, 21-22, 24, 26, 29, 30-33 & 34-35 **Accepted** in 5 sectors–17-18, 20, 25, 27-28, 36-37 **Rejected** - Total manufacturing	**Rejected** in 5 sectors - 01-02, 15-37, 45, 55, 85 **Accepted** in 7 sectors – 40-41, 50-52, 60-64, 65-67, 70-74, 80, 19-93 **Accepted** - Total economy
	T -test**		Sector specific factors	Sector specific factors
Theil coefficient *H7: No variation of inequality within and between regions over time*	**Regions**	***H7*** Productivity levels	**Rejected** - Total inequality is converging over time and is attributed to within region differences.	**Rejected** - Total inequality is diverging over time and is and is attributed to within region differences.
Theil coefficient *H8: No variation of inequality within and between sectors over time.*	**Sectors**	***H8*** Productivity levels	**Rejected** - Total inequality is converging and is attributed to between sector differences.	**Rejected** - Total inequality is diverging and is attributed to between sector differences.
Gini coefficient *H9: Perfect equality in productivity amongst the North East's sectors.*		***H9*** Output and Employment	Inconclusive – Gap widening	Inconclusive – Gap widening

* Regression coefficient **The regional and sector level t-test results were not statistically significant

8.2 Study limitations

Prior to discussing policy prescriptions based on the empirical evidence it is important to briefly point out the limitations of the study. In the first instance the data set on which the statistical analysis presented in chapters six and seven is based is subject to certain deficiencies. As with the examination of any data, the analysis is only as good as the quality of the original data. That is to say quantitative data are only as good as the methods used to collect and compile it. Chapter five explored in greater depth the weaknesses of the data and statistical tests. Despite these criticisms the data were obtained from a reliable national public source which must meet certain criteria, for example, be methodologically sound, politically independent and transparently produced. In addition all National Statistics are produced in accordance with the 'Framework for National Statistics' and therefore comply with the principles embodied in the 'National Statistics Code of Practice' which are reviewed every five years for quality.

Chapter five section 5.7.2 explored in greater depth the issue surrounding the level of disaggregation which in the context of this thesis relates to the sub-sectoral and the sub regional level. In general at the sub-sectoral level the results may differ – That is to say for example according to the 1992 SIC division 15-37 (which represents total manufacturing) may at the regional level show low productivity levels relative to the UK average but when further broken down according to 1992 SIC 17.4 group (which represents Manufacture of made-up textile articles, except apparel) the opposite may be apparent and vice-e-versa. This is further supported by Morris (2001) who finds that the broad manufacturing/services split explains little of the difference in outputs between UK regions. However at the sub-sectoral level, especially within the service sector, differences in the structure can be important in explaining differences in growth performance (for example the South East contains a smaller proportion of the slowest growing service sub-sectors *distributions, hotels, catering* and *Government* and *other services* and has a larger proportion of stronger performing service sub-sectors such as *business and financial services.* At the sub regional level this is also apparent - that is say at the NUTS 1 level a region may show an above UK average productivity level but at the NUTS 2 the sub regional level or even at the NUTS 3 Local level certain sub regions and local areas may show the opposite and vice-e-versa. According to European Commission (2001) UK variation in sub-regional GDP per capita is large by international standards, in particular compared to the US. In 1998 at the sub-regional level (NUTS 2) the UK had the highest variation in GDP per capita of any EU country, as measured by the coefficient of variation (HMT *et al.,* (2001) However sub regional data needs to be treated with caution since statistical problems increase with a higher level of detail (Thisse, 2000). In addition manufacturing statistics are more disaggregated than for services.

The empirical evidence underpinned by the shift share analysis has proved to be crucial hence it will be briefly critiqued (see Chapter 5 section 5.7 for an in-depth discussion). The most the shift share is capable of doing is to indicate, very broadly, the association between a region's industry mix and its growth performance. The unexplained residual also tells us something in so far as it is a measure of the growth performance of individual industries relative to their national counterparts. But this is as far as the technique is capable of taking us in the absence of further information. It is certainly not possible to infer, as some early users of shift share analysis did, that the separation of a region's growth into a structural and residual can be used to indicate what type of policy is required to improve the region's growth performance. It has been suggested for instance that if a region is growing slowly because of a predominance of slow growing industries, the appropriate policy would be to inject new growth industries into the region; and if a region is growing slowly because individual industries are growing less rapidly in that region than in other regions, it is argued that the region must be suffering from other locational disadvantages or inefficient production methods. In the case of locational disadvantages, new infrastructures would be required to improve the locational efficiency of the region. In the absence of other information to support such assertions, however it would be extremely dangerous to rely on shift share analysis to determine the type of policy instruments required in particular instances. Despite all these limitations this thesis has presented some crucial findings which are able to inform policy makers.

8.3 Policy – North East

Whether regional disparities are declining or growing within UK is currently a central question in both academic and policy communities. In the academic community, new endogenous growth theorists based on Myrdal's (1963) work on cumulative causation leading to persistent divergence, increasing disparities over time, while neo-classical theorist suggest that diminishing returns trend to produce convergence (see Alasia, 2002). The issues are important to policy as a process of cumulative advantage suggests the need to bolster lagging regions which have been generated by path dependencies[183] of previous actions and are exogenous. To achieve higher growth and reduce these gaps is challenging. Governments must first ensure that the fundamentals: macro-economic stability, openness and competition, and that economic and social institution are working properly in order to improve growth.

[183] Theories of path dependence imply a role for economic history not only in explaining the past, but also in explaining the present.

This thesis sought to explore whether the industrial structure of a region can constrain its future growth. Chapter two explored the issue whether specialisation in specific industries or services as opposed to sectoral diversity is more favourable for regional growth and development. Hence the empirical investigation explored whether the industry mix of the North East was the cause of its slow productivity growth performance: all hypotheses were broken down into two components the first considered manufacturing sub sectors and the second considered the total economy. As pointed out earlier, manufacturing is a prominent feature of the North East regional economy, accounting for an above UK average share of output and employment. The industry mix results for the North East (*H2a*) reported manufacturing to be converging to the national average over time which is further supported by data observations (see Appendices 5, 8 & 9) which show a decline in the share of manufacturing output and employment at the national and regional level. However the industry mix results for the regional economy (*H2b*) as a whole reported divergence which is explained by the above UK average share of manufacturing output and employment and in particular by the below UK average share of non manufacturing sectors such as the *Real estate, renting and business activities* sector (see Appendices 5, 8 & 9). The contribution of the industry mix to the difference between national and regional (North East) output per worker was 14% for manufacturing and 22% for the total economy.

Generally productivity is low across all sectors of the North East; hence it is not sector specific and confined to manufacturing. The results obtained for *H2a* and *H2b* revealed that the North East has less productive sectors relative to the UK average based on the productivity differential component (see Table 52 & Table 53). The productivity differential component for the North East for both manufacturing (Table 58) and the total economy (Table 59) represented approximately 70% of the shift implying that the sectoral structure of the North East economy is not the cause of productivity differences. The North East regional economic strategy consultation document (2005) acknowledges the North East is over reliant on low growth and low value added sectors and activities. According to the empirical findings of Esteban (2000) regional specialisation appears to have a minor role in explaining inter-regional inequality in productivity. Inter-regional productivity differences are common across all sectors and there seem to be uniform productivity short falls in poorer regions.

The inter-regional variance analysis also revealed that the industry mix does not explain the differences between national and regional output per worker across UK regions. But in fact region specific productivity differentials account for virtually all inter-regional differences in output per worker. These regional specific productivity differentials are explained by the variation between UK regions in two factors (employment and productivity) that underlie regional economic differences which are further supported by the results obtained for *H5* which point to region specific factors. Chapter three revealed the persistent differentials in economic performance between UK regions in a number of factors (skills, investment, innovation, enterprise and competition) that underlie an economy's productivity. It is the differences in regional performance against each of these factors that will have an impact on region's relative economic performance and help explain why certain regions are unable to fulfil their productive potential. Therefore it is regional specific and not sectoral. Chapter three observed that the North East lags behind the UK average and its regional counterparts on most standard measures of performance such as the five drivers of productivity.

In addition the empirical evidence reveals that the productivity gap between the UK and the North East is widening over time leading to divergence (see *H2a* and *H2b*) as revealed by the high share of the productivity differential component in the explanatory equation. The productivity differential component focuses on the contribution of sectoral productivity differences to the shift between regional and national average productivities when the national industry mix is imposed. There are a number of complex factors which help explain why the North East exhibits below UK average productivity levels which contribute to divergence. Factors also include:

Low participation and low employment rates - Chapter three revealed that the North East suffers from relatively low participation rates and low employment which in part can be explained by the decline in manufacturing. Employment and participation rates are two important factors determining economic performance. Chapter four section 4.9.2 explored the inter-relationship between employment and productivity. The link between employment, productivity and aggregate output are linked to each other as follows: *Output = Employment x Productivity.* The equation means that any given level of output can be achieved either with high productivity and low employment (where the employment intensity of economic growth is said to be low) or conversely, with low productivity and high employment (a high employment intensity).

Low skills economy - Chapter three also revealed that the North East region is a low skills economy where labour skills in the region are low which implies poor quality of labour inputs and capital stock.

Stage of the supply chain - According to the North East regional economic strategy consultation document (2005) the North East is at the early stage of the supply chain hence is involved in low value added operations explained by the poor quality of labour inputs and capital stock.

Price Pressure - The North East exports more than its UK regional counterparts therefore is subject to price pressure which intern has an impact on GVA (see chapter 4 section 4.6.4).

Best Practice - The North East regional economic strategy consultation document (2005) highlights that company operation are distant from best practices and research and development which have resulted in the reduced productivity capacity of the region.

Globalisation - Slow growth can be partly reflected in the characteristics of the region, for example in its unique mix of industries and businesses with a stronger reliance on manufacturing and a lower share of internationally tradable services than the UK as a whole. Data observations presented in Chapter three (Table 5) showed the share of manufacturing output and employment in the North East to be greater than the UK average and hence manufacturing to be a prominent feature of the North East landscape. Chapter four (Table 33 and Table 34) showed the decline in the share of manufacturing output and employment at the national level and at the regional level (see Appendix 5 and 8). Chapter four, section 4.3.1 (Figure 5) also revealed how the proportion of output and employment accounted for by manufacturing as a percentage of GDP had fallen during 1973-1997 in the UK. The decline in manufacturing output at relative prices and employment was explained by the increased flow of goods, services, money, and ideas across national borders and the subsequent integration of the global economy since the late 1990s, commonly referred to as globalisation. The effect of globalisation on manufacturing has meant that outsourcing and offshoring have brought about global competitive pressures. Whilst there has been a decline in manufacturing at the national and regional level there has been an increase in output and employment in the service sector most notably the *Real estate, renting and business activities* sector (70-74) which represent a large share of employment and output. The service sector is important for policy because it represents an overwhelming majority of output and labour in most developed economies as well as in the UK. Additionally in the developing economies the growth of services is expanding rapidly in terms of output, employment and in some cases productivity. Thus both employment and productivity gains can be achieved in this rapidly expanding sector, warranting further investigation into the impact of the service sector expansion on the total economy. In addition the decline in manufacturing employment should not be a case for arguing for protectionist policies and subsidies as demonstrated by the theory of comparative advantage. Therefore policy at the regional level needs to manage the labour shift from manufacturing to services. In the early 1950's there was a well established view in economics which viewed manufacturing as 'the engine of growth' dated to the work of Lewis (1954) and Kaldor (1966). It was argued that productivity growth increased faster in manufacturing than services and hence manufacturing was argued to have a more dynamic impact on output growth than services. However since the early 1990's globalisation has played a pivotal role in the transformation of developed economies particularly with reference to the location of manufacturing.

In an article published by the Economist (2005) titled '*The great jobs switch*' the fall in manufacturing employment in developed economies is regarded to be a sign of economic progress and not decline. The article points out that the shrinking of manufacturing jobs is a sign that economies are healthy. It further explains that the continued growth in manufacturing output has not been caused by mass substitution of Chinese goods for locally made ones, but instead it has occurred because rich world companies have replaced workers with new technology to boost productivity and shifted production from labour-intensive products such as textiles to high-tech, higher value added sectors such as pharmaceuticals. Within firms low-skilled jobs have moved offshore and higher value R&D design and marketing jobs have remained in the UK. Faster productivity growth means higher average incomes. Low rates of unemployment in the countries which have shifted away from manufacturing suggest than the most laid-off workers have found new jobs. Employment in rich countries will have to shift towards higher skilled jobs to maintain economic growth. Employment in rich countries will have to shift towards higher skilled jobs to maintain economic growth. Countries/regions that prevent this shift taking place risk being left behind.

De-industrialisation - the shrinking of industrial jobs- is popularly perceived as a symptom of economic decline. On the contrary, it is a natural stage of economic development. As country gets richer, it is inevitable that a smaller proportion of workers will be needed in manufacturing. The first reason is that household need only so many cars, fridges and microwaves, so as they become richer they tend to spend a larger share of their income on services such as holidays, health and education rather than goods. Secondly it is easier to automate manufacturing than services by replacing people by machines. Faster productivity growth than in services means that manufacturing requires fewer workers. In turn as workers move into more productive areas this gives a boost to overall productivity and hence living standards.

More generally the division between manufacturing and services has become distinct. A more sensible split now is between low-skilled and high-skilled jobs. Neither manufacturing nor services is better than the other; they are independent. The issue is not whether people work in factories or not, but whether they are creating wealth. Manufacturing once delivered the highest value added, high tech industries, such as drugs and aerospace, still do. But developed economies today, telecoms, software, banking and so on can create more wealth than making jeans or trainers. Future prosperity will not depend on how economic activity is labelled, but on economies ability to innovate and their capacity to adjust.

Rigidity is embedded within the regional performance. Three key arguments provide explanations as to what has bought about this rigidity.

1) Subsidies and other forms of regional support have frequently been used as an attempt to cushion structural change by protecting stagnating and declining industries. However, changes in industrial composition are a key factor associated with driving regional economic growth and convergence (Caseilli *et al.*, 2001; Overman *et al.*, 2002). Hence such policies frequently sacrifice long-term regional productivity and employment growth for short term employment gains. In the past regional policy instruments pursued in the UK have focussed on subsidy and failure rather than tackling market failures and building upon the indigenous strengths of regions and countries.
2) Gunnar Myrdal (1957) explained the backwardness of developing nations with the theory of cumulative causation. In his theory increasing returns in faster developing regions set in motion a process where production factors (mainly human capital) move away from the slower developing regions. Thus the catch-up in productivity between regions is likely to be a slow process, therefore having an effect on a region's growth trend path.
3) It is often argued that differences between unemployment rates for countries or regions are in part explicable in terms of the different degrees of labour market "rigidity" or "flexibility". Price shocks arising in conditions of "rigid" labour markets are thought to lead to

higher structural unemployment, while "flexible" labour markets allow adjustments to such shocks with no or little employment loss (Klau *et al.,* 1986). Hence inflexible labour markets combined with high welfare costs are often thought to be the main cause of low growth.

8.4 North East Challenge

As pointed out in the joint HMT and DTI report (2001) regional and local polices in the past have often failed because they have taken a short-term perspective and have not taken into account the complex interrelationships between the factors that are essential to economic success. In addition the report recognised that persistent shortfalls in productivity and employment are the likely results of coordination failures that prevent under performing regions and localities from taking advantage of agglomerations. This has meant that regions suffer from market failures such as poor adjustment to shocks in labour markets on account of barriers to labour mobility.

The key to the success of regional and local economic development programmes lies in creating comprehensive policy packages. Programmes to build regional economic capacity and human and social capital are complemented by policies to build a network of firms capable of sustaining high levels of growth without persistent Government finance (Arzeni & Pellgrin (1997) OECD LEED (1999a). In addition poor regional and local economic policy design has been compounded by ineffective Government institutions. The success of polices implemented in the well performing regions is to a substantial extent attributable to better administrative incentives. Local and region specific knowledge and an integrated and coordinated policy solution mean that incentives for

Government institutions charged with regional and local economic development policy are crucial (OECD LEED, 1999a).

The challenge for the North East therefore lies in changing the region's trend growth path. It becomes apparent that rigidity is embedded within the regional performance and its key cause is cumulative causation which is affecting its growth trend path, secondly it is argued that in the past regional policy, which was based on subsidy aid has been counter effective in that it has contributed to regional rigidity. The North East therefore needs to encourage flexibility. Factors which contribute to flexibility include;

1. Stable national economic growth (which the UK has experienced since 1992)
2. Decentralisation of regionalisation
3. The provision of good resource signals

Conclusion

The high degree of persistence of regional differentials points to significant problems in under performing regions. Neo-classical growth theory would suggest that market forces should result in convergence of GDP per capita over time (Barro and Sala-i-Martin, 1995). A lack of convergence in the medium to long term is therefore a likely indicator of serious market failures in a number of UK regions and countries (HMT, 2001). Romer (1986) in a classic paper sparked the new growth theory which provided a mechanism and corresponding economic explanation for why capital might not suffer from diminishing returns. In particular Romer (1986) focused on the possibility of external effects: for example, research and development efforts by one firm may spill over and effect the stock of knowledge available to all firms.

The Government's ambition to close the productivity gap between more and less developed regions through development policies focussing on providing the conditions in which regions and localities can successfully take advantage of new technological opportunities and structural change. Policies are focused on factors uniformly affecting productivity in poorer regions, such as the skill composition or competition policy.

The economic framework aims to tackle market and coordination failures as the likely cause of the shortfall in the productive potential of all the localities, regions and countries in the UK. The Governments approach to closing the productivity gap by tackling market failures is underpinned by endogenous growth theory whereby the determinants of technical change are placed at the heart of the economics of growth. By making technical change interact with economic forces, endogenous growth theory provides a framework in which Government policies can affect the long-term growth of an economy whereas standard neo-classical growth analysis does not allow for a policy impact. Leaving aside details of policy implementation, the empirical evidence presented in this thesis therefore supports the theoretical basis for the design of polices underpinned by endogenous growth theory.

The empirical evidence revealed that during the period 1991-2000 the North East was one of the slowest growing regions of the United Kingdom and levels of prosperity were among the lowest in the country. Generally productivity is low across all sectors of the North East; hence it is not sector specific and confined to manufacturing. The crucial finding this thesis has established is that the differences in productivity levels in the North East are not related to differences in the industrial structure as supported by the shift share results which revealed that the productivity differential component was the principal factor associated with the differences in the shift (*H2*) as opposed to the sectoral composition. This thesis supports the Government's current approach to dealing with regional disparities by focussing on the drivers of productivity. It does not therefore support policies aimed specifically at sector development. The empirical findings of Esteban (2000) have proven to strengthen and support the results this thesis has established which disclose that regional specialisation appears to have a minor role in explaining inter-regional inequality in productivity and that inter-regional productivity differences are common across all sectors and there seem to be uniform productivity short falls in poorer regions.

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Appendix 1 Social and economic characteristics of the UK regions

The following section has been adapted from an earlier paper submitted by the author (2000). The following section considers socio-economic position of the North East in comparison the rest of the UK which has been adapted from Regional Trends, No 34.

North East

Sectoral focus has tended to be in electronics, plastics, pharmaceuticals, materials, biotechnology, clothing textiles and engineering. According to Peck and Stone (1992) the NE tended to recruit a much higher proportion of lower skilled operatives and assembly workers. Lower skilled vacancies were filled from the unemployed register but skilled vacancies were increasingly poached from other firms in the area. The emphasis of training programmes was not on new skills per se, but changing existing skills to meet the specific needs of the inward investors.

The North East average class size at primary school is below the UK average it also has the poorest record in the UK of pupils achieving A-C in GCSE grades. It has the highest unemployment percentage (9.8) together with the highest long-term unemployment (43.8%) followed closely behind Northern Ireland. The male and female economic activity rates are both below the UK average being place 3rd lowest for males and 2nd lowest for females. On a whole the economic activity rate in the North East is the 4th poorest.

The North East has the highest proportion of its workers in the Construction industry and the lowest in the distribution industry. Males in the NE are 3rd in line with regards to the poorest weekly earnings in and women's earnings are the poorest in comparison to all its UK counterparts. Weekly earnings are of all persons in this region the lowest closely ahead of Northern Ireland.

Northwest & Merseyside

This region is made up of 2 great metropolitan areas. It is the largest region outside London and then Southeast. The region has more derelict land than any other region - a huge brown field resource for development.

Unemployment in this region is below the UK average (7.1%) it stands at 6.9%. The economic activity rate amongst males is the 11th lowest, amongst females it stands in 7th position. The proportion of GDP spent by a region on Research and Development in Business was 12%, Government 4.4% and on HE was 7.8%.

This region received 10% of total investment projects according to the DTI regions. When considering the allocation of funding this region received 21% of total funding which was the most received by any region.

Yorkshire and Humber

Four fifths of this region is rural in nature, including the East coast, the uplands of North Yorkshire and former coalfields. Over the past two decade this region has suffered the run down of the coal industry, a decline in heavy engineering, textiles and fishing and the restructuring of the coal industry.

When considering unemployment in this region it is above the UK average it stands at 8.1%. The economic activity rate amongst males, females stands at 6th and 5th position. The overall economic activity rate is below the UK average (78.0), which stands in 6th place. The GDP for the region is 90 it stands at the 8th lowest region. This region received

10% of total investment projects according to the DTI regions. When considering the allocation of funding this region received 8.9% of funding.

East Midlands

The East Midlands covers 12% of England's total land area with 7% of the population situated there. Unemployment in this region is below the UK average it stands at 6.3%. The economic activity rate is in 3rd position for females and 5th position for males, taking the overall activity rate of all persons to 4th position. The economic activity rate in all three categories is above the UK average. The average class sizes in this region are more or less equivalent to the Southeast and west but the amount of pupils achieving passes is the 8th lowest. The GDP stands in 6th position with the West midlands. The proportion of GDP spent by a region on research and development in Business was 7%, Government was 3.4% and on Higher Education was 5% of the UK total. The investment in non-manufacturing was 13.6%, and in manufacturing 11.7% of the total UK projects. The East Midlands obtained 12.8% of the total projects and received 3% of total EU structural funding.

West Midlands

Collis and Roberts (1992) reported for the West Midlands a significant growth in the number of jobs, mainly men, created by foreign owned companies. They also made important contribution to the regions skill base. Local purchases of capital equipment and business services were high but local sourcing of physical outputs was not.

When considering the unemployment rate in this it stands at 6.8%, which is below the UK average. The economic activity rate amongst females and males is below the UK average. The GDP for this region is equal to the East Midlands and stands at 94. The proportion of GDP spent on research and development in HE stands at 5.4%, on Government 9.7% and finally on business stands at 6.8%. The investment in non-manufacturing was 3.6%, and in manufacturing 11.7% of the total UK projects. The West Midlands obtained 12.8% of the total projects and received 10.8% of the total EU structural funding.

Eastern

The east of England has a population of just under five and a half million. This region has one of the fastest growing populations in the UK. The region stretches from the edge of London in the south to the remote coastal and rural areas of the north and east.

When considering the unemployment rate in this region it stands at 5.9% which is 1.2% below the UK average (the 2nd lowest). The economic activity rate amongst females and all persons is the 2nd highest in comparison to the rest of the UK regions. The economic activity rate amongst males was the 3rd highest. The GDP for this region stands at 97. The proportion of GDP spent on research and development in the HE stands at 7.4%, on Government 12% and finally on Business stands at 24%. The investment in non-manufacturing was 6.9%, manufacturing 3.6% of the total UK projects. The Eastern region obtained 5% of the total projects and received 0.8% of total EU structural funding the lowest of all UK regions.

London

This region has a high the second highest unemployment rate. The weekly earnings of persons working in London amongst males and females is the highest of that of the UK regions. London has the highest GDP 140.

More interesting is when considering interregional movement a smaller proportion of people are entering the region opposed to the amount leaving the region to join neighbouring regions more so the Southeast are and the eastern region. London spent the highest proportion of research and development on HE institutions

Southeast

This region was not as industrialised as the Northern regions, hence not as affected by the de-industrialisation process. These areas were and continue to lead in high technology and service industries. The South East has attracted large amounts of investment projects opposed to the other regions of the UK it is the most prosperous region in the UK. It specialises in commerce, banking finance and Government.

This region has the lowest unemployment rate in the UK equal to that of the Southwest. It has the highest economic activity rate amongst males and females in the UK. The weekly earning of person in the Southeast are the 2nd highest together with the 2nd highest GDP (107) in the whole of the UK.

When considering Inter -regional in the Southeast more people are moving into the region 24 thousand than those moving out. A majority are coming from London and the South West. Expenditure on research and development in the southeast was the highest in the whole of the economy in the business and Government.

Southwest

This region has the lowest unemployment rate in the UK equal to that of the Southeast. It has the highest economic activity rate amongst males and females are on par with the Southeast.

This region has the highest number of people moving into the region 32 thousand to be precise. Destinations of persons moving into this region are primarily the Southeast.

Wales

Wales was traditionally a heavy coal and steel region like North East and Scotland. Today it has become a more diversified economy based on manufacturing and services.

Unemployment in Wales is above the UK average (7.1%) it stands at 8.4%. Wales has the poorest economic activity rate amongst males in the UK as a whole. The economic activity rate amongst all persons is the 11th lowest. The average class sizes in Wales is the second lowest which then leads onto the pupils achieving A-C in GCSE passes is the 2nd highest. Wales has the 2nd lowest GDP. The proportion of GDP spent on Government and HE is the 10th lowest with spending on Business the 11th lowest.

Scotland

Sectoral focus is food, electronics, financial services, software, healthcare, biotechnology and optoelectronics. Turok (1993) in a survey of the Scottish electronics industry found only 12% of material inputs were sourced in Scotland. This proportion has stayed constant over time. The sectors where the Scottish economy makes contributions are lower skilled, lower valued items such as packaging. There are few high value added technology based linkages.

Scotland has the smallest number of class sizes at primary and secondary school opposed to its UK counterparts and has the highest percentage of pupils achieving grade a-C in GCSE's.

Northern Ireland

This region had the largest population growth of 4.5%. It also had the highest long-term unemployment rate of 55.4%, 16.6% above the UK average. Hence the lowest economic rate (72.1%) 5.9% below UK average. When considering jobs by industry it is interesting to note that it has the highest proportion of people in the agriculture, public administration and education domain opposed to the lowest percentage of persons in the transport and financial industry. People in Northern have the lowest weekly earning in the UK of £332.6, with men also earning the least amount of money (£367.7) in comparison to its UK (£425.6) counterparts. It also has the lowest GDP in the UK of 81. Northern Ireland attracted the least amount of direct investment projects in the UK.

When considering expenditure on research and development this region spent the lowest amount on business (81mil), Government (12 mil) HE institutions (52 mil). Northern Ireland was second in line with regards to receiving the largest amount of EU structural funding and Government expenditure on regional preferential assistance to industry.

Key Trends An explanation of the highlighted indicators selected are explained below.

- ***Employment Performance indicators*** - These show the Unemployment rates of the various regions.
- ***Economic activity rates*** - These are spit into two categories according to male and females and the then all persons. The economic activity rate is shows the wealth returned to a region.
- ***Education and skills*** - This shows the average class sizes at primary and secondary school together with the amount of pupils achieving a-c passes is GCSE's.

- ***GDP*** - The Gross Domestic Product shows the monetary value of all the goods and services provided by an economy over a specified period.
- ***Research and Development*** - This table shows the proportion of GDP spent by a region on research and development in Business, Government and Higher Education domains.

- ***Investment*** - The investment table shows the amount of direct inward investment project successes in manufacturing and non-manufacturing.. A project success is defined as where an overseas company specifies an interest and successfully completes investment in a UK company.

Employment Performance Indicators

Region	Unemployment % 1997
North East	9.80%
North West & Merseyside	6.90%
Yorkshire & Humber	8.10%
East Midlands	6.30%
West Midlands	6.80%
East	5.90%
London	9.10%
South East	5.20%
South West	5.20%
Wales	8.40%
Scotland	8.50%
Northern Ireland	7.50%
UK	7.10%

Unemployment in the North East is the highest closely followed by London. The Southeast and Southwest have the lowest unemployment.

Economic activity rates % 1998

Region	Males	Females	All
North East	79.4 (10)	65.3 (9)	72.7(10)
North West & Merseyside	79.2 (11)	68.4 (7)	74.0 (9)
Yorkshire & Humber	82.8 (6)	71.3 (5)	77.4 (6)
East Midlands	85.9 (5)	74.0 (3)	80.2 (4)
West Midlands	85.7 (4)	71.3 (5)	78.9 (5)
East	88.1 (3)	74.8 (2)	81.8 (2)
London	82.6 (7)	69.3 (6)	76.1 (8)
South East	88.7 (1)	75.7 (1)	82.5 (1)
South West	86.6 (2)	75.7 (1)	81.5 (3)
Wales	76.9 (12)	67.3 (8)	72.3(11)
Scotland	82.1 (8)	72.0 (4)	77.2 (7)
Northern Ireland	80.6 (9)	63.1 (10)	72.1(12)
UK	83.9	71.5	78

When considering the economic activity rates among male's Wales has the **lowest** closely followed by Northwest and the North East. The **highest** economic activity rate amongst males is in the Southeast. To follow on when considering the economic activity rates amongst women the **highest** exists in the Southeast and Southwest regions and **lowest** in Northern Ireland. The Overall Economic activity rate is the **lowest** in Northern Ireland and the **highest** in the Southeast.

Education and Skills

Region	*Class Sizes*		
	Primary	Secondary	Pupils achieving A-C in GCSE
North East	26.7	23.3	19.9
North West & Merseyside	27.6	21.9	25.1
Yorkshire & Humber	27.7	22.2	22.5
East Midlands	27.6	21.8	23.1
West Midlands	27	22	23.1
East	27.1	21.3	26.6
London	27.3	21.8	24.1
South East	27.7	21.7	31.4
South West	27.7	22	30.1
Wales	25.6	20.6	34
Scotland	24.9	19.2	36.5
Northern Ireland	24.3		

When considering average class sizes at primary school Northern Ireland followed by Scotland have the **smallest** class sizes. The regions with the **largest** are Yorkshire and Humber, Southeast and Southwest at primary school. Class sizes at primary school show Scotland with the **smallest** and the North East with the **largest**.

The North East has the poorest record of GCSE results among 16 year olds with Scotland having the highest. One could argue there is a very strong relationship between class sizes at secondary school and pupils achieving A-C in their GCSE results.

Gross Domestic Product

Region	GDP Per Head	Ranking
North East	85	9
North West & Merseyside	91	7
Yorkshire & Humber	90	8
East Midlands	94	6
West Midlands	94	6
East	97	4
London	141	1
South East	107	2
South West	95	5
Wales	83	10
Scotland	99	3
Northern Ireland	81	11
UK	100	

The GDP Table shows that London has the highest GDP of all the regions followed by the Southeast. Northern Ireland has the lowest GDP followed by Wales and the North East.

Research and Development (£ - million)

Region	Business		Government		HE	
North East	216	(10)	17	(11)	101	(11)
North West & M	1,187	(3)	88	(7)	228	(5)
Yorkshire & Humber	256	(9)	55	(9)	229	(4)
East Midlands	679	(6)	69	(8)	151	(8)
West Midlands	647	(7)	185	(5)	156	(7)
East	2,303	(1)	250	(3)	214	(6)
London	659	(5)	205	(4)	729	(1)
South East	2,296	(2)	685	(1)	434	(2)
South West	760	(4)	257	(2)	129	(9)
Wales	113	(11)	33	(10)	111	(10)
Scotland	356	(8)	163	(6)	357	(3)
Northern Ireland	81	(12)	12	(12)	52 (12)	
UK	9,553		2,018		2,891	

The proportion of GDP spent by a region on research and development varies accordingly with the eastern region spending 3.1% on business and with Wales spending a mere 0.3% the lowest *(UK1.2)*. To follow GDP spent by a region on Government varies with the **highest** London at 0.5% and the **Lowest** was North East, Northwest, Yorkshire and Humber, East Midlands, Wales and Northern Ireland all at 0.1%. *(UK0.2%)*Finally expenditure as a % GDP on HE institutions, Scotland was the **highest** 0.5% and the Southeast and the West Midlands had the **lowest** 0.2%. *(0.4%)*

Investment

DTI Region	Manufacturing		Non - Manufacturing		Total	
North East	35	(6)	12	(7)	47	(7)
North West & M	43	(5)	28	(3)	71	(4)
Yorkshire & Humber	45	(4)	20	(4)	65	(5)
East Midlands	12	(10)	11	(8)	23	(11)
West Midlands	49	(2)	32	(2)	81	(2)
East	13	(9)	19	(5)	32	(9)
South East	22	(7)	95	(1)	117	(1)
South West	22	(7)	18	(6)	40	(8)
Wales	50	(1)	5	(9)	55	(6)
Scotland	48	(3)	28	(3)	76	(3)
Northern Ireland	19	(8)	5	(9)	24	(10)
UK		358		273		631

When considering investment projects it interesting to note (according to the DTI regions) in the first instance 57% of the total projects in the UK were in the manufacturing domain opposed to 43% in non-manufacturing. The Southeast had the highest number of projects 117 in total 81% of them in **non-manufacturing**. The following regions had the lowest amount of investment projects in the same domain. Wales (9%), Northern Ireland (21%) and North East (26%)

When considering **manufacturing** Wales (91%) Northern Ireland (79%), the North East (74%) had the **highest** proportion of projects opposed to London with the **Lowest** at (19%)

Regional Profile

Regions	North East	North West + Merseyside	Yorkshire & Humber	East Midlands	West Midlands	Eastern	London	Southeast	Southwest	Wales	Scotland	Northern Ireland	U.K.
Social & Economic Statistics													
Population (k) 1997	2,594.40	6,884.60	5,037.00	4,158.30	5,320.80	5,334.20	7,122.20	7,958.80	4,876.00	2,926.90	5,122.50	1,680.30	59,008.60
Total Population Growth % 1991-97	-0.3	-	1.1	3	1.1	3.6	3.4	3.6	3.4	1.2	0.3	4.5	2.1
Education & Training													
Average Class size 1998-99													
Primary School	26.7	27.6	27.7	27.6	27	27.1	27.3	27.7	27.7	25.6	24.9	24.3	27.1
Secondary School	22.3	21.9	22.2	21.8	22	21.3	21.8	21.7	22	20.6	19.2		
Pupils achieving Grades													
A-C in GGSE – All	19.9	25.1	22.5	23.1	23.1	26.6	24.1	31.4	30.1	34	36.5		
Males	15.5	20.8	17.9	19	18.8	21.8	20.3	26.9	25	30.9	30.9		
Females	24.5	29.7	27.3	27.6	27.6	31.5	28	36.1	35.5	37.1	42.2		
Labour Market													
Unemployment (%) 1997	9.8	6.9	8.1	6.3	6.8	5.9	9.1	5.2	5.2	8.4	8.5	7.5	7.1
Long-term Unemployed as a % of unemployed in 1997	43.8	38	38.8	36.8	42	35.3	44	32.8	31.2	36.4	37.9	55.4	38.8
Labour Force (K) Males	662	1,758	1,358	1,169	1,481	1,550	1,934	2,250	1,346	713	1,359	417	15,997
(1998) Females	496	1,413	1,069	931	1,132	1,199	1,555	1,814	1,094	577	1,125	311	12,716
All persons	1,157	3,171	2,427	2,100	2,613	2,748	3,489	4,064	2,440	1,291	2,484	728	28,713
Economic Activity % Males	79.4	79.2	82.8	85.9	85.7	88.1	82.6	88.7	86.6	76.9	82.1	80.6	83.9
(1998) Females	65.3	68.4	71.3	74	71.3	74.8	69.3	75.7	75.7	67.3	72	63.1	71.5
All Persons	72.7	74	77.4	80.2	78.9	81.8	76.1	82.5	81.5	72.3	77.2	72.1	78
Job by industry:													
Agriculture	0.2	0.2	0.2	0.4	0.2	0.5	0.1	0.5	0.3	0.2	0.6	2.7	0.5
Mining	0.4	0.2	0.4	0.5	0.2	0.2	0.1	0.2	0.3	0.4	1.3	0.3	0.6
Manufacturing	21.2	20.7	21.9	25.8	26.5	17.7	8.2	14	17.3	22.2	16.4	18	25.2
Electricity	0.6	0.7	0.6	0.6	0.7	0.6	0.2	0.7	0.9	0.6	0.8	0.7	0.9
Construction	5.9	4.5	4.7	4.4	4.3	4.5	3.2	4.2	4.2	4.8	5.6	4.7	7.3
Distribution	20.9	23.2	22.5	21.8	21.6	24.5	21.9	23.9	24.2	21.7	22.7	20.9	20.9
Transport	5	5.5	5.9	5	4.8	6.4	7.8	6.3	5	4.4	5.3	4	8.3
Financial	12.4	15.5	14.9	14.2	15.1	19	30.8	21.7	16.4	11.3	14.8	8.4	17.3
Public Admin	7	5.9	4.9	4.6	5	4.6	6.1	5.5	6.8	7.4	6.4	9.9	6
Education	21.5	19.3	19.6	18.7	17.8	17.5	15	18.7	20.3	22	21.2	25.8	8.8
Other	5	4.3	4.4	4	4	4.5	6.4	4.5	4.3	5	4.9	4.6	4.3
Whole Economy =100% k	448	1,292	981	828	1,089	1,027	1,767	1,600	918	481	959	299	11,689
Average Weekly Earnings													
Whole Economy – Males	377.5	404.4	378.7	387.8	399.1	416.7	565.6	435.9	392.4	376.4	394.6	367.7	425.6
(April 1998) Females	273.6	287.1	281	271.5	282.3	307.7	402.8	323.5	286.2	282.8	276.7	277.6	308.7
All Persons	339.2	361.6	344.9	350.4	358.8	378.6	500.9	405.5	354	343.9	350.3	332.6	383.1

	North East	North West + Merseyside	Yorkshire & Humber	East Midlands	West Midlands	Eastern	London	Southeast	Southwest	Wales	Scotland	Northern Ireland	UK
Industry & Agriculture													
GDP per head (PPS) EU15=100 1996	85	91	89	94	93	97	140	107	95	83	98	81	100
DTI REGIONS *Direct Investment Project Success*: Manufacturing	35	43	45	12	49	13		22	22	50	48	19	358
Non-manufacturing	12	28	20	11	32	19		95	18	5	28	5	273
TOTAL	47	71	65	23	81	32		117	40	55	76	24	631
Expenditure on R&D 1997 (£ mill)													
Business	216	1,187	256	679	647	2,303	659	2,296	760	113	356	81	9,553
Government	17	88	55	69	185	250	205	685	257	33	163	12	2,018
HE institutions	101	228	229	151	156	214	729	434	129	111	357	52	2,891
Exp. As % of regional GDP													
Businesses	0.8	1.4	0.4	1.3	1	3.1	1.8	1.2	1.3	0.3	0.5	0.4	1.2
Government	0.1	0.1	0.1	0.1	0.3	0.3	0.5	0.4	0.3	0.1	0.2	0.1	0.2
HE institutions	0.4	0.3	0.4	0.3	0.2	0.3	0.3	0.2	0.3	0.3	0.5	0.3	0.4
Allocation of EU structural funds (1999) Objective 1	0	113	0	0	0	0	0	0	0	0	43	170	326
Objective 2	82	100	84	23	102	0	23	4	8	49	101	0	577
Objective 5b	4	4	6	8	6	8	0	0	28	23	18	0	103
Objective 1,2 & 5b	86	216	90	31	108	8	23	4	36	72	162	170	1,005
Government expenditure on Regional preferential assistance to industry (£ mil) 1997-98	38.1	19.4	12.7	10.5	29.8	2.2	5.4	2.7	4.5	172.6	132.5	156.1	430.4
GDP as factor costs current prices (1996) £ Million	25,590	66,978	48,268	41,813	53,249	54,850	106,658	90,440	49,097	25,998	54,430	14,469	629,839
£ Per head	9,071	9,719	9,585	10,096	10,016	10,363	15,077	11,455	10,141	8,900	10,614	8,699	10,711
£ Per head (UK =100)	85	91	90	94	94	97	141	107	95	83	99	81	100
Inter-regional Movements													
Outward (1997)	45	117	100	97	104	125	222	206	112	54	53	13	
Inward (1997)	39	107	93	108	93	145	167	230	144	59	55	10	
Difference	-6	-10	-7	-11	-11	-20	-55	24	32	5	-2	-3	

Source: Regional Trends No. 34

Appendix 2 Regional Policy in the UK

In essence the purpose of regional policy is to reduce regional disparities. It is widely recognised that persistent regional disparities have a profound negative effect on the national economy (Armstrong & Taylor, 2000). This section will first discuss the various approaches which deal with regional disparity and then review regional policy in the UK.

Two very different approaches can be taken to reduce regional disparity underpinned by a particular political ideology. The first being the free market approach which views the regional problem as being a result of market inefficiencies, a lack of entrepreneurial culture and excessive state intervention. The market based approach solution to reducing regional unemployment disparities argues the removal of constraints on the free operation of market forces. Regional policy should be minimal and financial assistance needed should be selectively provided with tight controls placed on regional policy spending.

The second approach is direct state intervention which has been later referred to as *spatial Keynesianism* (Martin, 1989). This approach views that the regional problem is caused by structural weaknesses in the regional economy, coupled with a fundamental deficiency of investment due to a drain of financial capital from poor to rich regions (Martin and Minus, 1995). The revival of the regional problem requires supply-side driven policies in order to rebuild the industrial and commercial base of these areas which requires Government involvement at the local, regional, national levels.

Table A: Two opposite approaches to reducing regional disparities

Characteristics of the free market approach	Characteristics of the interventionist approach
Political ideology	
Neoclassical economics Popular Capitalism Deregulation, privatisation Small state sector Enterprise culture	Supply-side support Keynesianism for industry and commerce Sate intervention
Causes of regional economic disparity	
Inefficiency problem in regions due to labour market rigidities Lack of entrepreneurial Culture Excessive state intervention	Structural weaknesses Drain out capital to rich regions Inadequate Government participation in regional development
Approach to reviving disadvantaged regions	
Deregulation of regional labour markets Tax incentives to improve efficiency	Proactive polices at regional and local level Public investment in infrastructure
Regional policy	
Minimal Expenditure Selective assistance	Excessive region aid Decentralisation of regional regeneration powers to local and regional agencies and authorities.

Source: adapted from Martin (1989)

As pointed out earlier purpose of regional policy is to reduce regional disparities which have a profound negative effect on the national economy (Armstrong & Taylor, 2000). However, it was not until the interwar period that there occurred both a formal recognition and an active policy towards disadvantaged regions in the United Kingdom. As far back as 1928, the Government set up the Industrial Transference Board to subsidise the movement of labour out of areas of industrial decline to prosperous areas. This was recognised as the labour mobility policy. During the interwar slump, harsh economic and social conditions in the regions of Wales, Scotland, Northern Ireland and Northern England induced the Government to introduce the Special Areas (Development and Improvement) Act 1934. Under the Act, two[184]

[184] One for England and Wales and the other for Scotland.

commissioners were established who were responsible for initiating, organising, prosecuting and designing measures of assistance to facilitate the economic development and social improvement of four areas[185].

The Special Areas Act of 1934 was of significance in UK regional policy due to two fundamental reasons. Firstly, it marked the beginning of an approach to regional problems based on the principle of 'taking work to the workers' opposed to 'moving the workers to the work'. Secondly, the objective of reducing regional disparities in unemployment became the guiding principle underlying all subsequent regional policy in Britain. However Middleton (1985) pointed out that the interwar regional policy of late 1930s was characterised by three important deficiencies. Firstly, regional policy was considered in isolation from other micro and macroeconomic policy instruments and objectives. Writers on interwar regional policy failed to acknowledge that virtually all Government policies will affect the economic and social life having differential spatial impacts. Secondly, there existed no assessment of interwar policy in light of the current well-established economic criteria for measurement. Thirdly, discussions of interwar policy were considered in isolation of regional policy when considering the economy's management.

The White Paper *Employment Policy* in 1944 was seen as a turning point in regional policy as it committed post war Governments to a policy of full employment and the acceptance of Keynesian views on the desirability of Government intervention. The Labour Government in 1945 introduced a variety of policy instruments through the Distribution of Industry Act 1945. The policy instruments included loans, grants to firms, powers to build factories and establish industrial estates, and the provision of basic services for industry. Subsidies were directed towards investment and this emphasis on capital grants persisted for two further decades. This

[185] South Wales, Durham & Tyneside, West Cumbria, Clydeside and North Lanarkshire.

was considered the most powerful regional policy instrument in the post war years. This was further reflected in a leap in the number of firms moving into assisted areas after 1945. Regional policy instruments introduced by the Labour Government of 1945 soon became associated with regional economic development. This is because the policy instruments were able to reduce regional disparities.

According to Keeble (1976, 1980), there was a significant shift in regional policy between the 1960s and 1970s. He argues how, under the Labour Government of Harold Wilson in the 1960s, regional policy was at its strongest. This was mainly due to strong policy instruments, such as Government assistance, which manifested in the form of offering financial incentives to companies to move to, or expand within, certain parts of the country recognised as Assisted Areas. Assisted Areas in England and Wales are defined in terms of economic indicators such as unemployment. The basic unit for designation is the travel to work area (TTWA). Parts of TTWAs may be designated in order to focus assistance on those parts most in need. There are two types of assisted area status, 'development areas' and 'intermediate areas'. Various grants and instruments of the central Government regional policies are directed towards improving economic and social conditions within the assisted area. Keeble therefore concluded that regional policy was significant in addressing regional disparities during the 1960s.

Keeble (1980) identified that the shift in regional policy during the 1970s was primarily due to the worsening economic condition which lead to a shift in Government policy. Policy instruments pursued in the 1960s were no longer valid and during the 1970s the UK was exposed to increased global competition. Many branch plant firms were relocating to the new emerging markets where labour and land was cheap.

By the 1980s the traditional rationale for conventional regional policy had been eroded. Radical changes became certain with the election in 1979 of the Conservative Government dedicated to the restoration of an economic policy closer to free market principles. However regional policy had not completely been abandoned. Regional policy became more selective both between areas and companies, spending was cut and the focus switched towards the enhancement of company competitiveness.

The UK Government's view of regional policy radically changed during the early 1990s. Regional policy had become entrenched as a component of the nation's *Industry Policy* (Armstrong & Taylor, 2000). In particular, the emphasis was placed on integrating regional policy into the drive to improve the *competitiveness* of industry in international markets. However the 1995 White Paper on *Regional Industrial Policy* argued that the principal aim of regional policy should be to increase the competitiveness of the Assisted Areas, both in terms of suitable locations for industrial activity and in terms of competitiveness of the individual firms within them. The 1995 White Paper further pointed out a re-emergence of social objectives, which during the recession of the early 1990s had not been considered. Therefore it was realised that regional industrial policy was to be refocused so that it reflected the role of achieving both economic and social objectives. The focus of regional policy in the late 1980s and the early 1990s was brought about by several developments, with four in particular worth noting.

First, it became recognised that less well off areas could play a substantial role in improving the competitiveness of the UK economy as a whole (DTI, 1995; DTI, 1998; Armstrong & Taylor 2000). All regions are now expected to contribute to improving the nation's competitiveness. Secondly, Regional Selective Assistance (RSA) is one of the few types of state aid to large firms permitted by the European Commission, which operates in selected regions. In particular RSA plays a significant role in attracting inward investment to the UK and has helped raise the profile of regional policy. This was detailed in the 1995 White Paper on *Regional Industrial Policy* which pointed out how the financial incentives enabled the United Kingdom to compete effectively for internationally mobile investment (DTI, 1995, p.2). At this point it is important to note that RSA is no longer available to existing firms which wish to relocate to Assisted Areas from within the UK, in order to avoid relocating problems as one firm could be encouraged to move from one geographical area to another.

Third, the European Union Structural Funds have become important as a means of improving the economic performance of the UK's less well off areas (Harrop 1996). There are four types of European Structural Fund, European Regional Development Fund (ERDF), European Social Fund (ESF), European Agricultural Guidance and Guarantee fund (EAGGF) and the Financial Instrument for Fisheries Guidance. Most structural fund spending is targeted on specific regions, known as Objective 1 and 2 regions. There are separate national Objective 3 programmes in England, Wales, Scotland and Northern Ireland. The aim of Objective 1 is to promote the development and structural adjustment of regions whose development is lagging behind. The aim of Objective 2 is to support the economic and social conversion of areas with structural difficulties. The aim of Objective 3 is to support the adaptation and modernisation of education, training and employment policies and systems.

Prior to 1999 there were six priority Objectives for the Structural Funds. However in 1999 revisions cut the number of priority Objectives to three for 2000-2006. The reasons for the cuts were primarily because the scope of objective 1, 2 and 5b was geographically limited. That is to say only certain regions or parts of regions - "eligible areas" - were able to benefit from the structural funds under these objectives (Decand, 2000). A region may have access to one or more of the Structural Funds depending whether it has Objective 1 or 2; all regions have Objective 3 status. Table 1 illustrates the type of funding available through the Objective Programme.

Table B: Structural Funding & Objective Area Eligibility
Adapted From: http://www.dti.gov.uk/europe/structural.htm (18 July 2001)

Type of Structural Funding	Objective Area Eligible for funding	Administration Framework*
ERDF provides financial support to regional development programmes targeted at the most disadvantaged regions. It aims to help reduce socio-economic imbalances between regions of the union.	Objective 1 and 2 areas	In England DETR[186]
ESF funds training, human resources and equal opportunities schemes to promote employability of people.	Objective 1 and 3 areas**	DfEE[187]
EAGGF aim to encourage the restructuring and diversification of rural areas, to promote economic prosperity and social inclusion, whilst protecting and maintaining environment and rural heritage.	Objective 1 areas	MAFF[188]
FIGG funds projects to modernise the structure of the fisheries sector and related industries to encourage diversification of the workforce and fisheries industry in together sectors	Objective 1 areas	MAFF

* DTI co-ordinates overall UK Government Policy on the Funds and takes the lead on many issues affecting more than one part of the UK
** In objective 2 ESF may be used in conjunction with ERDF

The central aim of these funds is to enhance competitiveness and to assist towards self sustained growth within places. It could be argued the UK Government's interest in Structural Funds may be in fixing its overall spending budgets whereby there is a substitution of EU projects for national schemes (Taylor & Wren, 1997). Table 2 illustrates how Regional Preferential Assistance, which includes, the Regional Development Grant, Regional Selective Assistance and the Regional Enterprise Grant has decreased whilst the annual allocation EU Structural Funds (Objective 1, 2 and 5b) have increased.

[186] Department of the Environment , Transport and Regions, now known as Department of Transport, Local Government and the Regions (DTLR).
[187] Department For Education and Employment, now known as Department For Education and Skills (DFES).
[188] Ministry of Agriculture, Fisheries and Food, has recently been taken over by the Department for Environment, Food and Rural Affairs (DEFRA).

Table C: UK Government expenditure on regional preferential assistance and allocation of EU Structural Funds to UK Assisted Areas: 1991-1995

Year	Expenditure on regional preferential assistance to industry (£m at 1997 prices)	Year	EU Structural Funds (£m at 1997 prices)
1991/92	566	1991	687
1992/93	470	1992	712
1993/94	512	1993	747
1994/95	502	1994	857
1995/96	474	1995	922

Source: Taylor & Wren, 1997, pp841

Finally, Structural Funds are now strongly focused on funding regional development programmes as opposed to individual projects. This has directly encouraged the formation of regional partnerships such as local authorities, TECS, economic development agencies and voluntary organisations, which are often led by a central Government regional office to apply for EU funding to support the economic regeneration of an area. These partnerships develop economic strategies that cover a wide geographical area and include a range of projects within each programme, therefore requiring regions, to draw-up development programmes in order to obtain EU funding. The emphasis of EU structural funds has led to the need for local and regional organisations to work in partnership to construct convincing economic cases for obtaining funds. European Structural Funding has come to play a fundamental role in UK regional policy and more recently in the formation of Regional Development Agencies.

Regional Development Agencies (RDAs) were established in April 1999 with a wide remit to promote the economic well being of the English regions in ways consistent with the goals of sustainable development and social inclusion. They have been designated 'lead bodies' at the regional level for co-ordinating inward investment, raising skills levels, improving business competitiveness and for social and physical regeneration.

Appendix 3 ICT breakdown of all industries (ISIC REV 3)*

1. Primary Production (Less intensive ICT using industries)	2. Non-Farm Business Sector						3. Government Services (Less intensive ICT using industries)
	2A : Manufacturing			2B : Services			
	ICT-Producing Manufacturing	Intensive ICT-Using manufacturing	Rest of manufacturing (Less intensive ICT using industries)	ICT- Producing services	Intensive ICT-Using Services	Rest of services /other industries (Less intensive ICT using industries)	
Agriculture (01)	Office & computing equipment (30)	Clothing (18)	Food, drink & tobacco (15-16)	Post & telecommunications (64)	Wholesale trade (51)	Repairs (50)	Public administration and defence (75)
forestry (02)	Insulated wire & cables (313)	Printing & publishing (22)	Textiles (17)	Computer & related services (72)	Retail trade (52)	Hotels & restaurants (55)	Education (80)
Fishing (05)	Semiconductor & other electronic components (321)	Machinery & equipment (29)	Leather & footwear (19)		Financial Intermediation (65)	Inland transport (60)	Health & Social work (85)
Mining (10-14)	Communication & broadcasting equipment (322)	Other electrical machinery (31EX 313)	Wood products (20)		Insurance & pension funding (66)	Water transport (61)	Other community social and personal services (90-93)
	Radio & TV receivers (323)	Other instruments (31. ex. 311)	Pulp & paper products (21)		Activities auxiliary to financial intermediation (67)	Air transport (61)	Private households with employed persons (95)
	Scientific instruments (331)	Building & repairing of ships & boats (351)	Oil refining & nuclear fuel (23)		Renting of machinery & equipment (71)	Auxiliary transport activities (63)	
		Aircraft & spacecraft (353)	Chemicals (24)		Research & development (73)	Real estate activities (70)	
		Railroad & transport equipment (352+359)	Rubber & plastics (25)		Professional business development (741-743)	Other business services (749)	
		Misc. Manufacturing (36-35)	Non-metallic mineral products (26)			Electricity, gas & water supply (40-41)	
			Basic metals (27)			Construction (45)	
			Fabricated metal products (28)				
			Motor vehicles (34)				

* ISIC rev 3 codes in brackets

Source: Denis, C *et al.* (2004) pg 26

Appendix 4 Top 10 industries in the EU and the US

Table 1: Top 10 industries in EU & US (Measured in terms of contribution to total labour productivity growth rate) 1996-2000

Industries (share of total value added/share of total labour input given in Brackets)	Contribution to Growth rate of Hourly labour productivity	Labour input*	GDP (value added)
EU			
1. Telecommunications (2.4/1.6)	0.24	0.01	0.24
2. Financial services (5.4/3.3)	0.16	0.02	0.2
3. Office machinery (0.2/0.1)	0.14	-0.03	0.06
4. Wholesale trade (5.0	0.12	-0.01	0.12
5. Wholesale Trade (5.0/4.0)	0.1	0.07	0.18
6. Agriculture (2.3/5.2)	0.1	-0.12	0.04
7. Semiconductors (0.2/0.1)	0.1	0.01	0.1
8. Chemicals (2.2/1.2)	0.09	-0.01	0.07
9. Retail trade (4.7/8.7)	0.07	0.09	0.12
10. Public administration & defence (6.8/7.3)	0.07	-0.02	0.05
Total of 10 industries (% share of All industries in Brackets)	1.18 (73)	0.0 (0)	1.18 (44)
US			
1. Wholesale trade (5.6/5.4)	0.47	0.08	0.05
2. Semiconductors (0.9/0.3)	0.46	0.01	0.49
3. Retail trade (6.5/10.5)	0.43	0.11	0.5
4. Financial services (7.1/4.4)	0.35	0.1	0.52
5. Office machinery (0.4/0.2)	0.24	-0.01	0.22
6. Agriculture (1.5/2.5)	0.16	-0.01	0.15
7. Telecommunications (2.4/1.6)	0.14	0.04	0.21
8. Real estate activities (10.3/1.2)	0.12	0.03	0.36
9. Public administration & defence (9.2/6.5)	0.08	0.02	0.11
10. Electricity, gas & water (2.6/0.8)	0.06	-0.01	0.02
Total of 10 industries (% share of All industries in Brackets)	2.50 (109)	0.37 (42)	3.12 (72)

*Employment adjusted for hours worked

Source: Denis Et al (2004)pg.32

Appendix 5 UK Output & Employment Shares

OUTPUT MSS

UK

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
17-18	6.40	6.24	5.75	5.88	5.94	5.29	4.92	4.59
19	1.12	1.01	0.80	0.72	0.65	0.61	0.58	0.52
20	1.81	1.58	1.62	1.64	1.73	1.75	1.71	1.75
21 + 22	14.40	15.43	14.82	14.68	14.18	14.49	15.31	15.86
24	12.87	12.96	12.91	12.72	11.82	11.51	11.71	11.85
25	5.66	6.03	5.72	5.84	6.16	6.27	6.10	5.97
26	4.14	3.88	4.35	4.20	4.00	3.83	3.84	3.93
27-28	13.59	13.10	13.59	13.27	13.16	13.50	12.83	12.49
29	9.97	9.78	10.35	10.08	10.31	10.36	9.80	9.45
30-33	14.62	14.49	14.97	15.04	15.42	15.38	16.04	16.73
34-35	12.19	11.81	11.02	11.58	12.03	12.27	12.29	11.97
36-37	3.22	3.70	4.09	4.36	4.62	4.76	4.88	4.88

UK

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	1.82	1.83	1.83	1.72	1.39	1.23	1.16	1.02
15-37	**18.62**	**18.02**	**19.09**	**18.87**	**18.58**	**17.51**	**16.58**	**15.86**
40-41	2.89	2.92	2.51	2.48	2.31	2.14	2.04	1.91
45	6.39	5.24	5.31	5.28	5.29	5.23	5.32	5.36
50-52	12.15	12.27	12.01	12.15	12.44	12.51	12.69	12.45
55	2.83	2.83	2.94	3.07	3.21	3.26	3.34	3.44
60-64	8.71	8.33	8.26	8.16	8.23	8.33	8.34	8.37
65-67	5.87	7.05	6.45	6.24	5.82	6.06	5.53	5.57
70-74	**18.09**	**18.44**	**19.16**	**19.65**	**20.54**	**21.85**	**22.83**	**23.60**
75	7.00	6.98	6.25	5.92	5.55	5.20	4.93	4.86
80	5.61	5.64	5.51	5.57	5.56	5.54	5.82	5.98
85	6.43	6.66	6.77	6.80	6.72	6.63	6.76	6.87
90-93	3.59	3.79	3.91	4.09	4.35	4.51	4.66	4.71

EMPLOYMENT MSS

UK

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
17-18	10.04	10.53	9.58	9.40	8.94	8.88	8.08	7.24
19	1.33	1.40	1.08	1.04	0.87	0.91	0.80	0.66
20	2.19	2.60	2.29	2.34	2.34	2.37	2.34	2.44
21 + 22	12.33	13.32	13.01	12.96	12.95	12.98	13.47	13.51
24	7.40	7.50	7.11	6.82	6.95	7.14	6.96	6.97
25	5.10	5.67	6.31	6.35	6.66	6.97	6.88	6.89
26	4.60	4.29	4.12	4.02	4.00	3.93	4.00	4.02
27-28	15.92	16.07	15.53	15.75	15.35	14.84	15.18	14.93
29	12.39	11.20	11.18	10.91	11.07	10.65	10.33	10.56
30-33	12.92	12.68	13.77	14.24	14.40	13.99	14.21	14.53
34-35	11.12	9.85	10.56	10.61	10.68	11.33	11.54	11.84
36-37	4.66	4.88	5.46	5.56	5.80	6.00	6.21	6.41

UK

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	1.47	1.60	1.34	1.34	1.72	1.16	1.07	0.99
15-37	**17.43**	**16.21**	**16.46**	**16.48**	**16.00**	**14.85**	**14.04**	**13.32**
40-41	1.06	0.96	0.76	0.67	0.64	0.56	0.49	0.53
45	4.81	4.12	4.16	3.96	4.44	4.67	4.68	4.60
50-52	16.80	17.10	17.12	17.23	17.28	18.24	17.97	18.08
55	5.70	5.70	5.60	5.69	5.71	6.56	6.61	6.53
60-64	6.40	6.27	6.04	5.99	5.88	5.90	6.08	6.18
65-67	4.81	4.59	4.53	4.39	4.34	4.30	4.39	4.26
70-74	**11.11**	**11.92**	**13.40**	**13.48**	**14.18**	**14.48**	**14.89**	**15.59**
75	6.80	6.92	6.39	6.38	5.89	5.85	5.65	5.59
80	8.20	8.28	8.02	8.22	7.98	7.91	8.38	8.47
85	11.14	11.67	11.51	11.34	11.14	10.73	10.70	10.80
90-93	4.25	4.64	4.65	4.85	4.80	4.79	5.06	5.06

Appendix 6 Calculating Productivity Growth

Productivity growth rates were calculated using the formula below:

$$r = EXP\left[LN\left(\frac{A}{B*t}\right)-1\right]*100$$

Where:

r = the rates of growth over the specified time period (1991-2000).

t = the time elapsed. In the case of this data series, the time elapsed in a majority of the cases was 10 years (1991-2000). However, there were certain exceptions as employment data was not available for certain years.

EXP = the exponential.
LN = the log appearance, which aims to smooth the data.
A = in this context refers to the productivity level in the year 2000
B = in this context refers to the productivity level in the year 1991.

This formula is also applied to output and employment (see Appendix 7)

Appendix 7 Annual average regional employment & output growth rates

Manufacturing Sub Sectors

Employment	sic sectors	UK	NE	NW	Y&H	EM	WM	E	L	SE	SW	W	S	NI
17-18	Textile & clothing	-4.68	-7.49	-3.10	-5.49	-4.34	-4.69	-3.41	-2.34	-4.77	-5.29	-6.28	-6.92	-4.95
19	Leather	-8.56	0.00	-11.31	-6.84	-8.00	-8.18	-6.90	-2.25	-9.87	-10.76	-16.69	-0.61	-6.65
20	Wood & wood products	0.02	-2.43	-2.32	3.18	0.14	0.77	-0.37	-3.44	0.65	-0.07	3.00	-0.49	1.57
21+22	Paper, printing & publishing	-0.14	-2.93	0.30	0.83	0.15	-1.63	-0.78	0.99	-1.02	0.35	0.07	-1.31	0.53
24	Chemical & man-made fibres	-1.81	-5.32	-2.36	-0.45	0.80	-3.40	-1.66	-3.30	0.56	-1.76	-2.65	-2.29	-0.64
25	Rubber & plastic products	2.18	6.98	1.46	2.14	2.87	-0.35	4.10	1.62	3.29	1.62	2.36	1.93	2.70
26	Non-metallic mineral products	-2.62	-3.75	-2.23	-2.07	-2.65	-3.62	-2.63	-1.06	-2.82	-1.70	-2.76	-3.72	3.62
27-28	Basic metals	-1.86	-3.18	-2.73	-2.88	-0.79	-1.39	0.15	-3.97	-0.62	0.26	-2.48	-3.86	2.73
29	Other metals	-2.90	-1.60	-4.80	-2.11	-3.29	-3.34	-2.56	-5.96	-1.93	-1.72	-2.64	-2.70	-0.91
30-33	Electronic & optical	0.14	1.62	-1.52	0.99	-1.05	-1.48	-2.62	-4.03	1.05	2.27	2.73	3.13	6.17
34-35	Transport equipment	-0.47	0.02	0.59	-0.74	1.96	0.08	-1.68	-2.33	-2.70	-0.64	2.34	-4.34	-0.46
36-37	Other manufacturing	2.41	2.32	3.30	1.72	3.78	0.96	3.21	2.12	2.41	3.88	3.08	1.91	4.27
15-37	Total manufacturing	-1.16	-1.85	0.26	-1.34	-1.20	-1.62	-1.05	-1.43	-0.38	-0.12	-0.27	-1.79	0.09

Output	sic sectors	UK	NE	NW	Y&H	EM	WM	E	L	SE	SW	W	S	NI
17-18	Textile & clothing	-2.57	-5.79	-2.52	-4.49	-2.83	-1.59	1.86	1.54	0.65	-0.48	-2.64	-5.32	-3.56
19	Leather	-7.25	-4.47	-11.10	-7.76	-6.38	-9.09	-4.73	-6.56	-2.02	-5.01	-14.07	-6.18	-10.29
20	Wood & wood products	0.76	-0.14	-0.27	0.63	0.01	0.38	16.43	-1.49	-0.10	0.11	1.38	-0.48	-1.37
21+22	Paper, printing & publishing	2.17	-0.54	0.35	2.76	1.52	-0.25	1.36	3.78	2.46	2.28	0.56	0.05	2.33
24	Chemical & man-made fibres	0.17	-1.53	-1.32	-2.21	0.76	-1.11	-0.25	1.00	2.67	1.16	0.63	0.76	0.89
25	Rubber & plastic products	1.69	1.61	1.79	3.50	1.95	0.22	1.55	-0.75	2.27	1.30	2.32	0.57	3.84
26	Non-metallic mineral products	0.50	-1.36	0.69	1.05	0.65	-0.46	1.37	3.23	1.50	-4.07	0.66	-0.59	3.48
27-28	Basic metals	0.15	-1.20	1.49	-0.52	0.88	-1.70	0.70	-1.22	2.64	2.77	-3.42	1.95	6.30
29	Other metals	0.49	-1.91	-1.80	-0.64	-0.73	1.00	2.38	-2.98	2.48	2.98	3.53	-1.78	4.37
30-33	Electronic & optical	2.61	0.09	0.94	4.50	0.53	0.55	-0.92	-2.23	3.80	6.43	2.70	5.66	11.94
34-35	Transport equipment	0.88	4.15	-0.13	-0.26	5.47	1.38	-2.40	-1.92	-0.27	2.21	1.48	-0.09	1.68
36-37	Other manufacturing	5.89	4.24	7.47	6.54	8.13	7.66	3.25	2.81	11.36	5.27	6.93	4.12	6.14
15-37	Total manufacturing	1.09	-0.43	-0.09	0.33	0.97	0.13	0.55	1.21	2.64	2.70	0.48	1.13	2.88

Total Economy

Employment	sic sectors	UK	NE	NW	Y&H	EM	WM	E	L	SE	SW	W	S	NI
01 + 02	Agriculture, hunting & forestry	-2.53	-3.18	-3.99	-3.69	-2.19	-3.47	-2.84	3.76	-2.49	-4.38	-5.47	3.19	-0.93
15-37	Manufacturing	-1.16	-1.85	0.26	-1.34	-1.20	-1.62	-1.05	-1.43	-0.38	-0.12	-0.27	-1.79	0.09
40-41	Electricity, gas and water supply	-5.68	0.98	-5.58	-9.40	-7.36	0.08	-3.97	-9.38	-8.28	-7.91	-3.00	-3.44	-6.74
45	Construction	1.33	-0.17	1.10	0.24	2.05	-0.91	3.26	1.31	2.89	3.25	2.58	-0.28	2.70
50-52	Wholesale & retail trade	2.67	1.88	2.15	2.19	2.25	2.72	3.13	2.69	3.69	3.17	2.32	1.62	3.47
55	Hotels & restaurants	3.38	2.26	4.58	2.47	4.15	2.92	4.66	5.20	4.40	1.75	0.68	2.72	6.74
60-64	Transport, storage and communications	1.44	-0.13	1.09	2.54	2.19	2.87	1.84	0.56	2.68	1.48	-0.40	0.07	2.32
65-67	Financial intermediation	0.46	-1.57	-0.49	1.04	-1.76	0.77	-1.25	1.41	0.20	-0.55	2.53	2.23	1.01
70-74	Real estate, renting and business activities	5.74	2.57	4.11	5.06	6.39	4.67	6.46	6.87	7.33	4.63	3.82	3.89	6.75
75	Public administration & defence	-0.35	-0.43	0.27	0.80	0.92	-0.83	-1.38	-1.78	-1.03	-0.25	-0.90	0.89	0.31
80	Education	2.20	0.18	2.90	2.60	0.71	2.92	1.28	2.57	2.31	3.68	2.87	1.32	1.26
85	Health & social work	1.48	2.52	1.03	0.88	2.25	1.70	2.08	0.69	1.00	1.93	2.42	1.61	1.60
90-93	Private households with employed persons	3.83	3.73	2.59	3.58	4.57	4.73	4.43	3.51	5.47	4.35	3.53	3.93	-5.94
	Total Economy	1.84	0.76	1.66	1.45	1.59	1.35	2.12	2.54	2.75	1.93	1.43	1.33	1.74

Output	sic sectors	UK	NE	NW	Y&H	EM	WM	E	L	SE	SW	W	S	NI
01 + 02	Agriculture, hunting & forestry	-3.56	-3.12	-3.71	-2.61	-3.13	-3.23	-4.27	-14.34	-4.59	-2.51	-3.04	-3.28	-5.63
15-37	Manufacturing	1.09	-0.43	-0.09	0.33	0.97	0.13	0.55	1.21	2.64	2.70	0.48	1.13	2.88
40-41	Electricity, gas and water supply	-1.71	2.53	-1.79	-3.35	-3.81	1.85	-1.45	-4.72	-2.53	-2.56	-1.41	2.18	-2.80
45	Construction	0.91	-1.27	0.63	1.17	1.61	0.47	1.59	0.78	1.27	0.29	0.52	0.39	5.56
50-52	Wholesale & retail trade	3.18	1.17	3.01	2.64	3.13	3.15	3.21	2.76	4.50	2.74	2.69	2.18	4.91
55	Hotels & restaurants	5.16	4.35	3.32	4.10	4.70	6.04	5.98	5.50	4.85	3.45	5.04	3.93	6.38
60-64	Transport, storage and communications	2.46	-0.23	1.86	2.64	2.53	3.08	2.46	2.33	3.98	2.14	0.68	0.81	4.33
65-67	Financial intermediation	2.30	0.46	1.68	3.04	1.00	2.65	-0.05	2.98	2.46	1.80	3.10	2.32	5.90
70-74	Real estate, renting and business activities	5.99	3.46	5.14	3.94	5.19	5.05	6.29	6.58	7.41	5.13	4.10	3.32	8.14
75	Public administration & defence	-1.19	-1.38	0.51	0.13	-0.10	-1.35	-0.35	-2.95	-1.21	-1.43	-1.35	1.08	-1.68
80	Education	3.64	1.63	4.38	3.30	5.24	3.81	4.00	3.20	3.38	4.45	3.92	0.51	2.61
85	Health & social work	3.68	4.14	3.87	3.77	4.16	3.83	3.37	2.70	2.99	3.96	4.44	2.50	1.67
90-93	Private households with employed persons	6.04	4.66	5.71	4.73	4.61	5.88	5.17	6.40	6.22	6.03	5.86	5.83	6.13
	Total Economy	2.90	1.20	2.36	2.13	2.53	2.42	2.75	3.51	3.90	2.61	2.09	1.91	3.03

Appendix 8 Regional Output & Employment Shares (Manufacturing Sub Sectors)

OUTPUT MSS

North East

sic sectors	1991 %	1993 %	1995 %	1996 %	1997 %	1998 %	1999 %	2000 %
17-18	5.92	5.40	5.32	4.84	5.49	4.69	3.64	3.60
19	0.26	0.24	0.18	0.16	0.20	0.20	0.18	0.18
20	1.92	1.98	2.32	2.03	2.43	2.29	1.83	1.97
21+22	8.85	9.03	8.65	7.39	7.82	7.70	7.21	8.77
24	21.54	21.13	20.58	17.97	19.48	19.28	17.12	19.50
25	6.13	6.04	5.85	5.50	6.92	7.35	6.50	7.37
26	3.37	3.04	3.46	2.86	3.02	2.83	2.55	3.10
27-28	15.91	16.03	16.72	13.92	15.06	15.48	13.06	14.84
29	13.24	11.59	11.07	9.47	11.18	11.39	10.08	11.57
30-33	11.52	11.72	12.12	10.76	12.29	12.02	10.61	12.08
34-35	8.60	10.34	9.90	9.51	12.02	12.62	11.48	12.90
36-37	2.73	3.46	3.84	3.43	4.09	4.15	3.75	4.13

North West

sic sectors	1991 %	1993 %	1995 %	1996 %	1997 %	1998 %	1999 %	2000 %
17-18	8.75	8.47	8.18	8.45	8.70	7.89	7.39	7.01
19	1.52	1.26	0.91	0.87	0.83	0.77	0.67	0.53
20	1.38	1.19	1.24	1.28	1.36	1.38	1.33	1.36
21+22	11.37	11.87	11.87	11.88	11.39	11.31	11.59	11.84
24	22.39	23.86	23.90	22.96	20.89	19.98	20.00	20.04
25	5.48	5.67	5.57	5.79	6.28	6.57	6.52	6.49
26	3.54	3.60	4.46	4.29	4.02	3.73	3.69	3.80
27-28	8.38	8.49	9.59	9.70	9.92	10.28	9.83	9.65
29	8.37	8.14	8.67	8.39	8.50	8.24	7.60	7.17
30-33	10.78	10.53	10.29	10.20	10.49	10.55	11.13	11.83
34-35	15.56	13.83	11.68	12.26	13.48	14.92	15.66	15.51
36-37	2.48	3.11	3.65	3.93	4.16	4.38	4.61	4.78

South East

sic sectors	1991 %	1993 %	1995 %	1996 %	1997 %	1998 %	1999 %	2000 %
17-18	1.44	1.32	1.27	1.35	1.43	1.32	1.29	1.21
19	0.26	0.25	0.21	0.18	0.17	0.18	0.19	0.17
20	1.96	1.32	1.25	1.31	1.45	1.51	1.49	1.54
21+22	17.38	18.26	17.47	17.22	16.48	16.41	16.89	17.11
24	17.83	18.91	18.72	18.48	17.29	17.09	17.62	17.89
25	5.04	4.99	4.48	4.67	5.13	5.32	5.11	4.88
26	3.10	2.58	2.81	2.75	2.72	2.64	2.70	2.80
27-28	8.04	8.00	8.52	8.49	8.60	8.91	8.40	8.05
29	10.80	10.22	10.68	10.64	11.20	11.56	11.04	10.65
30-33	22.52	22.24	23.33	23.57	24.13	23.58	24.01	24.92
34-35	10.25	10.47	9.54	9.31	8.95	8.65	8.33	7.92
36-37	1.38	1.43	1.71	2.01	2.44	2.82	2.94	2.87

South West

sic sectors	1991 %	1993 %	1995 %	1996 %	1997 %	1998 %	1999 %	2000 %
17-18	2.81	2.52	2.31	2.40	2.48	2.30	2.20	2.11
19	2.31	2.05	1.75	1.67	1.47	1.33	1.25	1.14
20	2.58	2.16	2.02	1.93	1.93	1.94	1.93	2.05
21+22	14.30	15.27	14.30	13.83	12.95	12.92	13.41	13.79
24	6.38	5.96	6.51	6.68	6.05	5.60	5.49	5.57
25	7.28	7.76	7.46	7.51	7.71	7.56	6.98	6.43
26	5.37	3.68	3.42	3.30	3.18	3.01	2.95	2.91
27-28	8.60	9.06	9.62	9.46	9.53	9.89	9.21	8.66
29	10.35	10.89	11.89	11.52	11.75	11.72	11.00	10.60
30-33	16.49	17.32	18.45	18.73	19.38	19.78	21.27	22.72
34-35	18.43	17.04	15.61	16.50	17.30	17.78	17.98	17.65
36-37	5.11	6.30	6.65	6.48	6.29	6.18	6.33	6.38

Wales

sic sectors	1991 %	1993 %	1995 %	1996 %	1997 %	1998 %	1999 %	2000 %
17-18	3.54	3.70	3.39	3.54	3.60	3.19	2.91	2.67
19	0.59	0.49	0.35	0.30	0.25	0.20	0.17	0.14
20	1.74	1.65	1.75	1.82	1.95	1.98	1.87	1.88
21+22	9.41	10.90	9.85	9.31	8.66	8.66	9.15	9.48
24	11.91	11.11	10.86	11.11	10.79	10.99	11.73	12.07
25	5.39	5.79	6.07	6.61	7.16	7.11	6.66	6.35
26	3.99	3.28	3.42	3.52	3.60	3.78	3.94	4.06
27-28	28.59	26.81	26.86	24.98	23.49	22.68	20.92	20.02
29	5.10	5.29	5.73	5.74	6.15	6.65	6.68	6.68
30-33	15.84	16.49	17.20	17.27	17.50	17.41	18.40	19.28
34-35	10.59	10.26	9.92	10.90	11.69	11.96	11.97	11.58
36-37	3.31	4.23	4.60	4.89	5.16	5.38	5.62	5.80

West Midlands

sic sectors	1991 %	1993 %	1995 %	1996 %	1997 %	1998 %	1999 %	2000 %
17-18	3.12	3.14	2.85	2.97	3.10	2.84	2.78	2.67
19	0.59	0.61	0.49	0.42	0.35	0.31	0.29	0.25
20	1.31	1.19	1.13	1.16	1.23	1.28	1.29	1.34
21+22	6.50	6.87	6.50	6.27	5.82	5.76	6.07	6.28
24	3.88	3.82	3.88	4.00	3.84	3.67	3.55	3.46
25	7.54	8.41	7.93	7.88	8.09	8.10	7.87	7.60
26	6.67	6.89	7.66	7.30	6.76	6.39	6.29	6.32
27-28	25.95	23.87	23.45	22.84	22.53	23.22	22.38	21.98
29	11.18	11.78	13.48	13.33	13.55	13.32	12.58	12.08
30-33	13.27	11.57	10.39	10.53	11.19	11.77	12.93	13.78
34-35	17.68	18.98	18.91	19.71	19.63	19.22	19.56	19.77
36-37	2.33	2.88	3.33	3.60	3.92	4.12	4.40	4.47

EMPLOYMENT MSS

North East

sic sectors	1991 %	1993 %	1995 %	1996 %	1997 %	1998 %	1999 %	2000 %
17-18	9.88	10.62	9.60	8.14	7.66	8.78	7.86	5.80
19	0.00	0.32	0.00	0.28	0.27	0.40	0.25	0.00
20	2.73	3.15	3.00	2.60	2.56	2.18	2.67	2.59
21+22	8.48	8.34	7.91	7.20	7.24	7.39	7.51	7.68
24	14.99	13.82	12.97	11.43	11.83	10.99	10.43	10.84
25	4.05	5.93	6.96	6.58	7.66	8.40	8.40	8.81
26	3.89	4.02	3.29	3.36	3.30	3.07	3.06	3.26
27-28	21.06	18.97	17.88	18.27	17.90	17.12	18.45	18.63
29	11.77	12.34	11.97	13.43	13.69	12.04	10.35	12.05
30-33	9.43	9.40	12.64	12.61	12.58	13.66	13.65	12.90
34-35	9.38	8.32	8.43	11.20	9.49	10.53	11.35	11.12
36-37	4.33	4.78	5.34	4.89	5.83	5.45	6.01	6.30

North West

sic sectors	1991 %	1993 %	1995 %	1996 %	1997 %	1998 %	1999 %	2000 %
17-18	13.56	13.41	13.42	13.44	12.94	11.05	9.95	9.98
19	1.99	1.87	1.47	1.40	1.16	1.04	0.72	0.60
20	2.19	2.71	1.92	2.01	2.00	1.75	1.61	1.74
21+22	10.00	11.60	11.48	12.25	11.56	9.67	9.60	10.04
24	12.14	12.90	11.72	11.52	12.60	10.39	9.97	9.57
25	5.61	5.87	6.67	6.99	6.84	6.46	6.40	6.24
26	3.58	3.56	3.63	3.65	3.32	3.11	2.98	2.85
27-28	13.25	12.26	12.01	12.58	12.25	10.19	10.14	10.10
29	11.63	9.43	9.85	9.40	9.69	7.22	7.66	7.30
30-33	10.15	10.64	10.61	10.18	10.44	8.26	8.41	8.64
34-35	11.43	10.56	11.53	10.92	11.61	11.03	11.47	11.78
36-37	4.47	5.18	5.69	5.66	5.59	4.85	5.16	5.85

South East

sic sectors	1991 %	1993 %	1995 %	1996 %	1997 %	1998 %	1999 %	2000 %
17-18	2.24	2.57	1.99	1.93	1.93	1.75	1.65	1.49
19	0.38	0.43	0.27	0.29	0.22	0.22	0.24	0.15
20	1.84	2.09	1.87	1.91	1.94	1.85	1.86	2.02
21+22	16.55	17.23	16.01	16.22	16.59	15.56	15.20	15.61
24	8.73	8.45	9.61	7.44	8.76	9.14	9.51	9.50
25	4.58	5.44	5.78	6.04	5.72	6.43	6.48	6.35
26	3.31	2.65	2.67	2.55	2.45	2.45	2.70	2.65
27-28	10.77	11.47	11.33	11.53	11.25	10.88	10.93	10.53
29	14.26	11.97	12.09	12.07	12.12	12.55	12.52	12.38
30-33	20.71	21.03	22.78	24.28	23.69	22.62	23.07	23.55
34-35	11.76	11.83	9.67	9.93	9.12	10.32	9.78	9.52
36-37	4.87	4.85	5.92	5.80	6.21	6.23	6.06	6.25

South West

sic sectors	1991 %	1993 %	1995 %	1996 %	1997 %	1998 %	1999 %	2000 %
17-18	4.62	5.27	4.30	4.05	4.21	3.70	3.59	2.86
19	2.89	2.92	1.98	1.52	0.89	1.43	1.54	1.05
20	2.80	2.57	2.65	2.67	2.65	2.68	2.86	2.81
21+22	12.54	13.22	12.89	12.94	12.53	12.94	13.19	13.08
24	4.96	5.08	4.82	4.20	3.99	4.34	4.03	4.27
25	6.39	6.22	7.60	7.05	8.14	8.12	7.94	7.47
26	3.83	3.46	3.47	3.33	3.08	3.24	3.22	3.32
27-28	11.02	13.72	11.47	12.54	12.15	11.76	11.42	11.41
29	13.07	13.31	12.60	11.88	12.49	12.70	11.61	11.30
30-33	15.23	14.02	18.77	18.88	18.74	18.16	17.79	18.84
34-35	18.48	15.69	14.79	15.69	15.38	15.06	16.64	17.63
36-37	4.18	4.50	4.66	5.26	5.76	5.87	6.16	5.96

Wales

sic sectors	1991 %	1993 %	1995 %	1996 %	1997 %	1998 %	1999 %	2000 %
17-18	7.21	6.68	5.72	6.28	5.90	5.78	4.87	4.12
19	0.00	0.77	0.62	0.51	0.47	0.33	0.16	0.23
20	1.95	2.20	2.14	2.40	2.23	2.90	2.20	2.61
21+22	9.09	9.89	9.67	9.13	8.68	8.82	8.54	9.36
24	7.28	6.20	5.30	5.55	5.84	6.26	6.43	5.86
25	5.42	6.15	6.71	7.12	7.46	7.53	7.50	6.85
26	4.05	3.19	3.32	3.44	3.58	3.73	3.30	3.23
27-28	24.48	22.24	22.20	20.11	21.18	20.93	21.53	20.01
29	10.10	8.42	6.43	6.98	6.11	7.90	7.88	8.13
30-33	14.97	17.34	20.40	19.71	19.98	18.35	18.93	19.55
34-35	9.00	10.34	10.32	11.46	10.65	9.72	11.11	11.35
36-37	6.46	6.58	7.17	7.32	7.91	7.75	7.56	8.69

West Midlands

sic sectors	1991 %	1993 %	1995 %	1996 %	1997 %	1998 %	1999 %	2000 %
17-18	4.91	5.61	4.04	4.24	4.24	4.38	4.14	3.69
19	0.65	0.73	0.55	0.56	0.47	0.45	0.42	0.35
20	1.39	1.80	1.65	1.67	1.69	1.69	1.74	1.73
21+22	5.74	6.08	5.79	5.65	5.66	5.70	5.77	5.73
24	2.83	3.10	2.63	2.81	2.49	2.70	2.55	2.41
25	6.55	7.39	7.60	7.53	7.47	7.69	7.50	7.36
26	8.69	8.26	7.73	7.87	8.05	7.14	7.13	7.23
27-28	25.47	27.35	26.92	26.51	25.21	25.39	26.12	26.01
29	13.86	12.84	12.43	12.34	12.38	11.95	11.74	11.83
30-33	10.46	10.13	9.27	10.31	10.35	10.81	11.05	10.59
34-35	15.24	12.38	16.98	15.86	17.12	17.20	16.45	17.78
36-37	4.20	4.33	4.41	4.67	4.87	4.90	5.39	5.31

OUTPUT MSS

East Midlands

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
17-18	14.98	14.72	13.79	13.94	13.82	12.28	11.37	10.60
19	3.62	3.39	2.89	2.58	2.25	2.08	2.05	1.84
20	2.11	1.71	1.60	1.57	1.61	1.70	1.74	1.94
21+22	10.34	11.01	10.32	10.09	9.62	9.91	10.49	10.86
24	9.19	8.62	8.52	8.53	8.10	8.13	8.63	9.03
25	6.47	6.85	6.35	6.44	6.78	7.00	6.95	7.06
26	5.43	5.23	5.94	5.67	5.39	5.11	5.12	5.28
27-28	12.85	12.93	13.45	13.04	12.77	13.25	12.90	12.75
29	11.38	10.38	11.25	11.19	11.44	11.32	10.39	9.77
30-33	9.96	9.49	9.17	8.94	8.74	8.63	9.07	9.58
34-35	10.82	11.90	12.19	13.23	14.50	15.49	16.12	16.02
36-37	2.85	3.78	4.52	4.79	4.99	5.10	5.18	5.28

Eastern

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
17-18	1.74	1.63	1.65	1.83	2.02	1.97	1.99	1.96
19	0.71	0.65	0.54	0.49	0.44	0.43	0.45	0.44
20	0.55	0.71	0.98	1.17	1.50	1.75	1.89	2.04
21+22	16.17	17.09	16.45	16.34	15.79	16.16	17.07	17.37
24	11.20	11.27	11.10	11.05	10.25	9.88	10.08	10.42
25	6.47	7.30	7.30	7.37	7.55	7.45	7.17	7.07
26	2.90	2.68	3.25	3.25	3.17	3.07	3.06	3.11
27-28	9.45	8.72	9.07	9.19	9.46	9.99	9.70	9.57
29	10.68	12.70	14.49	13.56	13.35	13.40	12.78	12.55
30-33	20.85	20.38	19.57	18.99	18.87	18.25	18.47	18.25
34-35	14.38	12.47	11.29	12.06	12.40	12.11	11.46	11.00
36-37	4.91	4.40	4.30	4.71	5.19	5.53	5.89	6.22

Scotland

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
17-18	10.01	9.60	8.30	8.32	8.06	6.84	6.02	5.53
19	0.62	0.48	0.33	0.29	0.28	0.29	0.32	0.32
20	2.87	2.68	2.66	2.55	2.50	2.50	2.37	2.49
21+22	14.42	15.03	13.15	12.68	11.85	11.93	12.39	13.09
24	10.66	9.49	10.10	10.62	10.39	10.44	10.70	10.32
25	4.84	5.18	4.36	4.19	4.25	4.40	4.45	4.61
26	4.05	3.52	3.51	3.43	3.33	3.31	3.34	3.47
27-28	10.44	10.54	11.57	11.45	11.63	11.91	11.44	11.23
29	11.17	10.10	8.76	8.16	8.29	8.58	8.40	8.60
30-33	20.11	22.97	28.38	29.09	29.95	29.73	30.39	29.84
34-35	8.78	8.28	6.78	6.95	7.07	7.52	7.66	7.88
36-37	2.02	2.13	2.10	2.26	2.39	2.54	2.53	2.62

London

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
17-18	4.26	4.10	3.76	4.19	4.92	4.80	4.65	4.39
19	1.07	1.07	0.73	0.61	0.56	0.62	0.60	0.52
20	1.44	1.42	1.65	1.57	1.48	1.31	1.13	1.13
21+22	36.88	40.78	41.81	42.23	41.89	43.05	44.64	46.25
24	11.79	11.76	11.73	11.07	10.36	10.44	11.25	11.57
25	3.28	3.44	3.14	3.11	3.17	3.13	2.91	2.75
26	1.28	1.26	1.51	1.46	1.41	1.44	1.50	1.53
27-28	7.27	6.44	6.04	5.91	6.09	6.38	6.17	5.84
29	6.60	5.36	4.72	4.49	4.70	4.80	4.62	4.51
30-33	14.50	13.13	12.22	11.70	11.57	10.97	10.77	10.63
34-35	6.35	5.58	6.37	7.03	7.13	6.66	5.67	4.78
36-37	5.28	5.67	6.32	6.62	6.72	6.41	6.09	6.09

Northern Ireland

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
17-18	20.66	20.81	18.84	18.31	17.44	14.91	13.08	11.54
19	0.86	0.61	0.40	0.31	0.24	0.24	0.25	0.25
20	4.18	3.58	3.33	3.14	3.09	3.09	2.83	2.86
21+22	9.87	10.43	9.75	9.58	9.13	9.39	9.47	9.41
24	9.80	9.79	10.30	10.47	9.63	9.33	9.09	8.22
25	6.76	6.89	6.20	6.43	7.21	7.66	7.48	7.35
26	5.88	6.04	6.79	6.52	6.17	6.00	6.01	6.19
27-28	5.16	5.79	6.54	6.53	6.90	7.08	6.94	6.92
29	6.19	8.09	9.95	9.34	8.75	8.08	7.16	7.04
30-33	9.17	9.70	11.73	12.34	13.00	14.30	17.13	19.59
34-35	18.42	14.79	12.40	13.12	14.44	15.90	16.53	16.58
36-37	3.06	3.48	3.76	3.91	3.99	4.03	4.03	4.05

Yorkshire & Humber

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
17-18	11.57	11.03	9.46	9.36	9.24	8.30	7.83	7.43
19	0.80	0.70	0.47	0.42	0.39	0.42	0.42	0.38
20	2.31	1.82	1.80	1.95	2.15	2.32	2.30	2.38
21+22	11.11	12.29	11.95	11.94	11.69	12.22	13.22	13.80
24	13.92	13.85	14.03	13.90	12.76	11.91	11.61	11.06
25	4.32	4.72	4.64	4.84	5.17	5.35	5.44	5.73
26	5.32	5.39	6.11	5.85	5.63	5.39	5.51	5.67
27-28	21.05	20.56	21.25	20.78	20.76	21.20	20.34	19.50
29	11.76	11.05	11.64	11.53	11.84	11.94	11.17	10.78
30-33	6.25	6.49	6.85	6.96	7.23	7.35	8.23	9.02
34-35	7.32	6.92	5.95	6.08	6.17	6.44	6.61	6.95
36-37	4.26	5.18	5.84	6.38	6.97	7.16	7.32	7.32

EMPLOYMENT MSS

East Midlands

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
17-18	21.78	21.99	21.17	20.43	18.66	19.65	17.86	16.29
19	4.43	4.18	3.21	3.41	3.13	3.12	2.74	2.33
20	2.35	2.36	2.18	2.07	2.34	2.24	2.37	2.65
21+22	9.18	9.37	9.44	9.06	9.50	9.49	9.92	10.38
24	4.85	4.57	6.28	6.73	5.98	6.03	5.82	5.80
25	5.12	5.81	6.41	5.58	6.76	7.07	7.03	7.36
26	5.40	5.48	5.14	4.54	4.60	4.35	4.81	4.73
27-28	13.35	13.57	12.92	13.84	13.60	12.58	13.89	13.85
29	12.34	11.64	11.42	11.22	11.94	10.61	10.11	10.18
30-33	8.76	8.53	8.08	8.49	8.37	8.14	8.43	8.88
34-35	7.93	7.78	8.24	8.70	9.09	10.01	10.50	10.53
36-37	4.51	4.72	5.52	5.93	6.05	6.71	6.51	7.01

Eastern

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
17-18	2.99	3.55	3.05	2.98	2.88	3.05	2.97	2.41
19	0.89	0.99	0.79	0.78	0.64	0.55	0.60	0.52
20	2.45	2.73	2.47	2.58	2.47	2.38	2.64	2.61
21+22	14.71	17.49	16.65	16.11	15.85	15.67	17.09	15.08
24	7.41	7.95	7.71	6.65	6.74	7.16	6.79	7.01
25	5.40	5.81	6.50	7.48	7.13	7.90	8.27	8.52
26	3.52	2.96	3.33	2.82	3.07	2.99	2.86	3.05
27-28	10.82	11.94	11.34	11.82	11.41	11.28	10.77	12.06
29	15.52	15.54	14.09	14.78	14.44	14.07	13.84	13.52
30-33	19.28	17.38	18.10	19.41	19.45	18.07	16.44	16.70
34-35	12.28	8.72	10.37	8.93	9.45	10.44	10.62	11.60
36-37	4.73	4.93	5.61	5.68	6.47	6.44	7.10	6.92

Scotland

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
17-18	14.57	15.42	13.47	14.20	12.25	11.76	11.15	8.98
19	0.32	0.50	0.55	0.53	0.45	0.41	0.41	0.36
20	2.95	4.09	3.55	3.87	3.67	3.75	3.55	3.32
21+22	11.80	12.63	11.45	11.54	11.66	11.59	12.13	12.32
24	6.82	6.57	5.54	5.81	6.06	6.49	6.20	6.52
25	3.61	3.72	5.24	5.17	5.98	5.34	5.00	5.05
26	4.31	4.10	3.63	3.22	3.17	3.58	3.52	3.61
27-28	15.00	14.05	12.61	14.35	13.58	13.21	12.84	12.38
29	11.86	11.14	12.00	9.56	9.76	9.55	9.17	10.90
30-33	16.18	16.49	19.55	20.04	22.16	22.81	24.31	25.13
34-35	10.06	8.56	9.24	8.53	7.89	8.06	8.25	7.94
36-37	2.51	2.73	3.17	3.19	3.37	3.45	3.48	3.50

London

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
17-18	7.60	9.22	8.47	7.95	9.19	8.48	7.82	6.99
19	0.89	1.71	1.23	1.06	0.95	1.08	0.90	0.82
20	1.77	2.55	1.66	2.03	1.79	1.54	1.51	1.47
21+22	32.56	34.70	37.15	37.76	38.56	39.36	40.84	40.47
24	8.62	7.78	6.54	7.60	5.79	6.65	6.59	7.26
25	3.36	4.59	3.77	4.00	4.30	4.44	3.85	4.41
26	1.81	1.53	1.50	1.80	1.62	1.82	1.79	1.87
27-28	10.73	10.24	9.44	9.15	8.35	7.79	7.54	8.48
29	8.05	5.41	6.44	4.78	5.62	5.03	5.50	5.27
30-33	13.55	12.30	12.72	12.11	12.06	10.93	10.91	10.64
34-35	6.37	4.82	5.31	5.77	5.65	6.44	6.25	5.86
36-37	4.70	5.13	5.77	6.01	6.12	6.44	6.51	6.46

Northern Ireland

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
17-18	30.78	30.50	29.18	27.79	27.04	25.45	22.64	19.32
19	0.78	0.77	0.63	0.62	0.47	0.47	0.49	0.42
20	3.36	3.41	3.56	3.65	3.67	3.49	3.43	3.83
21+22	7.15	7.77	7.47	7.46	7.46	7.61	7.84	7.43
24	4.05	4.68	4.51	4.42	4.54	4.30	4.04	3.79
25	6.56	7.17	7.66	7.75	7.83	7.93	8.35	8.26
26	4.87	4.82	4.84	5.32	5.16	5.33	6.01	6.65
27-28	5.78	6.03	6.32	6.22	6.72	6.57	7.11	7.30
29	8.49	8.23	7.91	8.34	7.85	7.72	7.86	7.75
30-33	9.05	8.87	10.60	11.27	11.88	12.81	12.86	15.39
34-35	15.84	14.44	13.48	13.35	13.40	13.81	14.50	15.07
36-37	3.31	3.30	3.83	3.80	3.99	4.51	4.87	4.78

Yorkshire & Humber

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
17-18	15.36	15.03	14.30	13.98	13.04	12.27	11.16	10.44
19	0.63	0.68	0.70	0.67	0.56	0.57	0.47	0.38
20	2.29	2.97	2.85	2.70	2.91	3.40	3.04	3.43
21+22	10.54	12.23	12.01	11.73	11.26	11.93	12.42	12.81
24	7.22	8.55	7.36	7.37	8.02	8.41	8.02	7.82
25	4.37	4.23	5.09	5.19	5.62	5.81	5.79	5.97
26	5.29	4.96	4.13	4.12	4.29	4.23	4.86	4.95
27-28	22.99	21.86	21.62	21.02	21.52	19.86	21.45	19.94
29	12.44	10.78	11.93	11.82	11.88	12.09	10.90	11.59
30-33	6.22	6.11	6.87	7.44	7.34	6.97	7.14	7.67
34-35	6.30	6.02	5.48	6.52	6.49	6.35	6.49	6.65
36-37	6.35	6.59	7.64	7.41	7.07	8.10	8.26	8.36

Appendix 9 Regional Output & Employment Shares (Total Economy)

OUTPUT TE

North East

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	0.90	0.88	0.89	0.82	0.73	0.68	0.65	0.61
15-37	**24.82**	**24.74**	**26.11**	**28.19**	**25.00**	**23.71**	**24.65**	**21.43**
40-41	2.56	2.73	2.62	2.53	2.54	2.61	2.75	2.88
45	7.19	5.71	5.69	5.49	5.82	5.74	5.58	5.76
50-52	11.00	10.96	10.51	10.25	10.89	11.07	10.92	10.97
55	2.48	2.47	2.58	2.63	2.88	2.99	3.05	3.26
60-64	8.21	7.70	7.73	7.57	7.89	7.79	7.19	7.22
65-67	3.53	3.81	3.30	3.14	3.13	3.42	3.11	3.31
70-74	**14.50**	**14.97**	**15.03**	**14.85**	**15.99**	**16.82**	**16.79**	**17.69**
75	7.12	7.55	6.73	6.16	5.99	5.71	5.38	5.64
80	7.22	7.17	6.89	6.60	6.68	6.65	6.92	7.50
85	7.34	7.90	8.35	8.17	8.51	8.65	8.85	9.49
90-93	3.14	3.40	3.59	3.58	3.96	4.16	4.16	4.25

North West

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	1.42	1.43	1.38	1.28	1.03	0.93	0.91	0.82
15-37	**23.81**	**22.87**	**23.86**	**22.99**	**22.29**	**20.93**	**19.94**	**19.15**
40-41	2.99	2.70	2.41	2.49	2.38	2.23	2.16	2.06
45	6.22	5.18	5.27	5.24	5.28	5.20	5.28	5.33
50-52	12.84	13.03	12.77	13.11	13.56	13.75	13.88	13.59
55	3.00	2.82	2.83	2.95	3.08	3.12	3.18	3.27
60-64	8.47	8.25	8.06	7.78	7.76	7.91	8.01	8.11
65-67	4.44	5.24	4.52	4.30	4.05	4.39	4.09	4.19
70-74	**15.73**	**16.28**	**16.98**	**17.49**	**18.20**	**19.16**	**19.60**	**20.02**
75	5.21	5.40	4.99	4.82	4.67	4.53	4.43	4.42
80	5.85	6.04	6.00	6.11	6.13	6.22	6.67	6.97
85	6.87	7.28	7.66	7.78	7.67	7.55	7.67	7.84
90-93	3.16	3.49	3.58	3.67	3.89	4.07	4.20	4.23

South East

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	1.47	1.40	1.33	1.23	0.98	0.85	0.78	0.68
15-37	**14.69**	**14.40**	**15.31**	**15.21**	**15.06**	**14.36**	**13.74**	**13.16**
40-41	2.79	3.05	2.57	2.36	2.07	1.82	1.71	1.57
45	6.57	5.22	5.34	5.32	5.27	5.15	5.19	5.22
50-52	12.38	12.43	12.25	12.48	12.93	13.12	13.34	13.04
55	2.57	2.54	2.64	2.66	2.64	2.60	2.68	2.79
60-64	9.44	9.32	9.50	9.46	9.56	9.63	9.53	9.51
65-67	5.94	6.78	6.23	6.08	5.67	5.76	5.24	5.24
70-74	**21.58**	**22.28**	**23.37**	**23.95**	**25.05**	**26.67**	**28.02**	**29.12**
75	8.19	7.95	6.92	6.56	6.19	5.76	5.38	5.20
80	4.76	4.80	4.68	4.68	4.55	4.39	4.49	4.55
85	6.14	6.24	6.19	6.15	5.94	5.71	5.66	5.68
90-93	3.48	3.60	3.68	3.86	4.08	4.18	4.24	4.24

South West

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	3.14	3.28	3.48	3.31	2.70	2.39	2.24	1.98
15-37	**16.69**	**16.28**	**17.59**	**17.78**	**18.11**	**17.69**	**17.24**	**16.82**
40-41	3.76	3.91	3.41	3.46	3.23	2.90	2.63	2.36
45	6.96	5.58	5.47	5.40	5.43	5.46	5.61	5.67
50-52	12.01	12.00	11.77	11.83	12.11	12.17	12.35	12.15
55	3.44	3.39	3.32	3.35	3.44	3.47	3.57	3.71
60-64	6.74	6.38	6.39	6.43	6.55	6.61	6.49	6.47
65-67	5.11	6.53	6.06	5.63	5.06	5.20	4.72	4.76
70-74	**17.41**	**17.43**	**17.98**	**18.26**	**18.98**	**20.16**	**21.03**	**21.66**
75	10.08	10.03	9.15	8.86	8.41	7.77	7.21	7.02
80	5.25	5.28	5.11	5.25	5.37	5.46	5.86	6.16
85	6.42	6.82	6.99	7.00	6.95	6.94	7.09	7.22
90-93	3.00	3.08	3.28	3.45	3.66	3.79	3.95	4.03

Wales

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	2.47	2.39	2.12	2.03	1.75	1.71	1.70	1.55
15-37	**25.06**	**23.90**	**25.95**	**25.66**	**25.25**	**23.91**	**22.60**	**21.71**
40-41	3.29	3.32	3.11	3.15	2.84	2.55	2.46	2.41
45	6.18	5.33	5.53	5.48	5.46	5.39	5.40	5.38
50-52	10.60	10.71	10.12	10.27	10.68	11.02	11.29	11.17
55	3.07	3.11	3.22	3.36	3.56	3.68	3.83	3.96
60-64	6.49	5.97	5.54	5.36	5.38	5.49	5.58	5.72
65-67	3.19	4.03	3.65	3.55	3.37	3.66	3.40	3.49
70-74	**13.88**	**14.36**	**14.42**	**14.49**	**14.94**	**15.71**	**16.23**	**16.54**
75	7.63	7.81	7.20	6.90	6.42	5.97	5.63	5.60
80	6.73	6.85	6.61	6.71	6.73	6.95	7.52	7.89
85	7.85	8.53	8.64	8.85	9.01	9.12	9.40	9.64
90-93	3.56	3.68	3.90	4.21	4.61	4.84	4.97	4.93

West Midlands

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	2.01	2.01	2.01	1.93	1.58	1.42	1.35	1.20
15-37	**27.44**	**26.00**	**27.45**	**27.06**	**26.59**	**25.03**	**23.32**	**22.20**
40-41	2.84	3.04	2.49	2.47	2.43	2.50	2.65	2.67
45	6.32	5.26	5.25	5.21	5.16	5.14	5.19	5.27
50-52	12.37	12.73	12.58	12.78	12.99	13.06	13.27	13.07
55	2.54	2.45	2.62	2.86	3.15	3.33	3.41	3.44
60-64	6.84	6.55	6.68	6.75	6.83	6.93	7.01	7.18
65-67	3.86	4.60	4.27	4.18	3.97	4.23	3.89	3.90
70-74	**15.87**	**16.14**	**16.41**	**16.69**	**17.31**	**18.36**	**19.17**	**19.76**
75	5.34	5.22	4.62	4.40	4.16	3.97	3.81	3.78
80	5.66	5.80	5.50	5.55	5.57	5.65	6.08	6.34
85	6.11	6.52	6.40	6.25	6.16	6.23	6.58	6.85
90-93	2.80	2.85	2.92	3.07	3.29	3.45	3.64	3.74

EMPLOYMENT TE

North East

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	0.73	0.85	0.70	0.73	0.98	0.60	0.55	0.51
15-37	**20.15**	**18.33**	**19.79**	**20.82**	**19.39**	**18.13**	**16.29**	**15.91**
40-41	0.78	0.70	0.90	0.65	0.56	0.55	0.64	0.79
45	6.47	5.83	5.54	5.47	5.97	5.61	5.96	5.95
50-52	15.09	16.03	15.24	15.10	15.66	16.43	16.80	16.67
55	5.49	5.06	5.09	5.53	5.64	6.54	6.99	6.27
60-64	5.47	5.45	5.10	5.28	5.13	4.91	4.81	5.05
65-67	2.72	2.63	2.33	2.25	2.14	2.27	2.14	2.20
70-74	**9.11**	**10.16**	**9.61**	**9.50**	**10.45**	**10.71**	**9.76**	**10.70**
75	8.21	8.90	8.03	8.78	7.12	7.41	8.23	7.38
80	9.78	8.75	9.19	8.03	8.44	8.60	8.91	9.29
85	11.69	12.22	13.51	12.95	13.47	12.80	13.35	13.67
90-93	4.31	5.08	4.96	4.89	5.06	5.44	5.55	5.60

North West

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	0.98	1.09	0.91	0.92	1.24	0.70	0.64	0.59
15-37	**19.89**	**18.80**	**18.93**	**18.55**	**18.29**	**18.98**	**18.09**	**17.55**
40-41	1.01	0.87	0.75	0.72	0.71	0.48	0.51	0.52
45	4.98	4.46	4.28	4.10	4.71	4.53	4.46	4.74
50-52	17.54	18.06	17.77	18.24	17.98	18.43	18.35	18.31
55	4.98	4.46	4.28	4.10	4.71	6.73	6.40	6.42
60-64	6.08	6.12	6.13	6.08	5.75	5.69	5.55	5.78
65-67	4.00	3.98	3.64	3.50	3.37	3.32	3.51	3.30
70-74	**10.15**	**10.63**	**11.93**	**11.69**	**12.66**	**12.28**	**12.52**	**12.57**
75	6.56	6.70	6.32	6.33	6.10	5.69	5.85	5.80
80	7.75	8.11	7.95	8.12	7.99	8.07	8.72	8.64
85	11.88	12.12	12.56	13.05	12.02	10.89	11.08	11.23
90-93	4.20	4.62	4.53	4.60	4.47	4.20	4.34	4.56

South East

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	1.79	1.78	1.50	1.53	2.00	1.36	1.24	1.12
15-37	**14.42**	**13.12**	**13.40**	**13.30**	**12.82**	**11.97**	**11.49**	**10.92**
40-41	1.19	1.04	0.74	0.69	0.66	0.53	0.42	0.43
45	4.26	3.07	3.44	3.51	4.18	4.27	4.27	4.31
50-52	18.11	18.44	18.39	18.69	18.42	19.90	19.32	19.66
55	5.54	5.56	5.28	5.46	5.38	6.16	6.28	6.40
60-64	6.73	6.36	6.51	6.25	6.24	6.32	6.78	6.70
65-67	4.96	4.62	4.44	4.35	4.17	4.19	4.11	3.96
70-74	**12.91**	**13.84**	**16.28**	**16.61**	**17.50**	**17.29**	**18.98**	**19.13**
75	6.45	7.02	5.66	5.74	5.46	5.43	4.63	4.60
80	8.61	9.04	8.74	8.91	8.50	7.90	8.34	8.28
85	11.08	11.90	11.38	10.39	10.16	10.04	9.42	9.50
90-93	3.95	4.22	4.24	4.57	4.51	4.63	4.73	4.99

South West

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	2.61	2.58	2.14	2.14	2.83	1.78	1.64	1.47
15-37	**15.78**	**15.08**	**15.18**	**15.35**	**14.97**	**14.43**	**13.84**	**13.14**
40-41	1.44	1.24	1.04	0.89	0.89	0.71	0.59	0.58
45	3.95	3.60	3.93	3.46	4.21	4.54	4.51	4.44
50-52	17.40	17.26	17.68	17.94	17.57	19.22	19.22	19.40
55	7.64	7.16	6.89	6.84	6.70	7.85	7.40	7.52
60-64	5.27	5.13	4.91	5.11	4.98	4.93	4.95	5.07
65-67	5.17	4.84	4.73	4.43	4.15	4.22	4.42	4.14
70-74	**9.83**	**10.08**	**11.75**	**11.63**	**12.31**	**12.02**	**12.37**	**12.44**
75	7.51	7.55	6.98	7.24	6.78	5.55	5.81	6.18
80	8.07	8.54	7.98	8.10	8.45	8.27	8.39	9.40
85	11.59	12.73	12.64	12.28	11.87	12.12	12.04	11.60
90-93	3.74	4.21	4.15	4.58	4.30	4.37	4.81	4.62

Wales

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	2.27	2.17	2.03	2.09	2.82	1.57	1.50	1.20
15-37	**19.44**	**19.74**	**20.08**	**20.21**	**19.84**	**18.23**	**17.66**	**16.69**
40-41	1.00	1.16	1.03	0.79	0.74	0.55	0.56	0.67
45	4.87	4.16	4.36	4.08	4.81	5.27	5.08	5.39
50-52	15.58	15.19	15.33	15.25	15.76	17.55	16.33	16.85
55	6.82	6.10	5.87	5.71	5.84	6.96	7.36	6.38
60-64	5.08	4.85	4.64	4.36	4.41	3.81	4.12	4.31
65-67	2.74	2.79	2.63	2.61	2.68	2.49	2.67	3.02
70-74	**7.51**	**7.60**	**8.58**	**7.88**	**8.58**	**8.61**	**9.33**	**9.26**
75	8.86	8.67	7.86	8.85	7.34	7.36	7.12	7.18
80	8.69	8.97	8.85	10.20	7.98	9.00	9.91	9.86
85	12.69	13.79	14.08	12.99	14.25	13.41	13.03	13.84
90-93	4.46	4.81	4.66	4.99	4.94	5.20	5.34	5.35

West Midlands

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	1.39	1.55	1.22	1.21	1.61	1.03	0.95	0.89
15-37	**26.54**	**23.68**	**25.31**	**24.92**	**24.57**	**22.67**	**21.48**	**20.06**
40-41	0.95	1.00	0.81	0.60	0.70	0.66	0.57	0.84
45	4.99	3.98	3.94	3.65	4.24	4.03	4.30	4.02
50-52	16.24	17.01	16.59	16.77	16.82	18.09	17.73	18.11
55	5.02	4.94	5.14	5.05	4.61	5.72	5.87	5.69
60-64	5.03	4.87	4.87	5.05	4.76	4.75	5.27	5.68
65-67	3.33	3.29	3.31	3.13	3.13	3.14	3.09	3.12
70-74	**9.48**	**10.42**	**10.99**	**11.91**	**11.88**	**12.57**	**12.59**	**12.51**
75	5.58	5.41	5.25	5.09	4.94	4.76	4.41	4.53
80	7.90	8.01	7.82	7.85	8.02	8.11	8.55	8.96
85	10.10	10.67	9.94	9.80	9.72	9.51	10.03	10.29
90-93	3.45	3.83	3.79	3.92	3.97	3.97	4.27	4.58

OUTPUT TE

East Midlands

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	2.84	2.99	2.86	2.75	2.16	1.89	1.85	1.70
15-37	**25.07**	**24.97**	**26.38**	**26.18**	**26.09**	**24.63**	**23.10**	**21.84**
40-41	3.51	3.47	2.87	2.92	2.68	2.38	2.12	1.98
45	6.88	5.78	5.63	5.53	5.64	5.76	6.03	6.35
50-52	13.42	13.75	13.66	13.76	13.93	13.84	14.19	14.15
55	2.46	2.43	2.54	2.68	2.78	2.84	2.91	2.98
60-64	7.30	7.06	6.72	6.42	6.40	6.68	6.89	7.30
65-67	3.63	4.05	3.52	3.33	3.18	3.41	3.18	3.17
70-74	**14.99**	**15.39**	**15.86**	**16.35**	**17.02**	**18.18**	**18.57**	**18.89**
75	5.58	5.43	4.91	4.80	4.57	4.39	4.41	4.42
80	5.26	5.31	5.28	5.51	5.66	5.92	6.38	6.65
85	6.12	6.44	6.82	6.64	6.51	6.54	6.76	7.05
90-93	2.94	2.93	2.94	3.12	3.38	3.55	3.61	3.53

Eastern

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	2.74	2.77	2.64	2.54	2.01	1.71	1.61	1.45
15-37	**16.88**	**16.38**	**17.02**	**16.75**	**16.54**	**15.58**	**14.66**	**13.90**
40-41	2.49	2.73	2.32	2.18	2.02	1.90	1.83	1.71
45	7.39	5.95	6.01	6.23	6.45	6.45	6.56	6.67
50-52	12.47	12.64	12.45	12.60	12.95	13.11	13.23	12.98
55	2.17	2.25	2.39	2.59	2.78	2.85	2.87	2.86
60-64	9.68	9.70	9.64	9.33	9.19	9.21	9.24	9.44
65-67	7.95	7.76	7.07	6.97	6.64	6.67	6.13	6.20
70-74	**18.28**	**19.03**	**20.06**	**20.60**	**21.52**	**22.99**	**24.04**	**24.80**
75	6.49	6.56	5.73	5.54	5.30	4.99	4.97	4.93
80	4.87	5.22	5.26	5.31	5.19	5.14	5.34	5.42
85	5.30	5.66	5.87	5.68	5.56	5.44	5.50	5.59
90-93	3.29	3.37	3.53	3.69	3.87	3.95	4.03	4.06

Scotland

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	2.40	2.43	2.45	2.25	1.86	1.67	1.58	1.50
15-37	**16.67**	**16.43**	**18.35**	**18.34**	**18.50**	**17.49**	**16.66**	**15.55**
40-41	2.98	3.26	3.25	3.60	3.58	3.39	3.17	3.05
45	7.16	6.20	6.40	6.12	6.01	5.92	6.02	6.25
50-52	11.21	11.39	10.76	10.85	11.05	11.16	11.47	11.48
55	3.41	3.58	3.73	3.92	4.01	4.05	4.06	4.07
60-64	8.70	8.17	7.92	7.88	7.87	7.91	7.73	7.89
65-67	4.89	5.78	5.43	5.30	5.02	5.30	4.95	5.06
70-74	**15.92**	**16.03**	**15.82**	**15.94**	**16.37**	**17.40**	**17.79**	**18.01**
75	8.00	7.94	7.34	7.31	7.08	6.93	7.23	7.43
80	7.26	6.88	6.57	6.65	6.48	6.22	6.26	6.41
85	7.75	7.88	7.90	7.62	7.65	7.76	8.02	8.17
90-93	3.65	4.04	4.06	4.23	4.52	4.81	5.06	5.12

London

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	0.08	0.05	0.05	0.04	0.02	0.01	0.00	0.01
15-37	**10.71**	**10.07**	**10.33**	**10.14**	**9.97**	**9.37**	**9.17**	**8.75**
40-41	2.17	2.02	1.56	1.38	1.23	1.09	1.06	1.03
45	4.74	3.65	3.69	3.72	3.71	3.58	3.63	3.73
50-52	11.68	11.70	11.42	11.28	11.21	11.04	11.13	10.94
55	3.22	3.17	3.37	3.54	3.68	3.66	3.80	3.82
60-64	11.28	10.26	10.08	9.99	10.12	10.12	10.09	10.18
65-67	10.46	13.59	12.77	12.32	11.07	11.51	10.09	10.00
70-74	**24.32**	**24.23**	**25.89**	**26.89**	**28.32**	**29.77**	**31.06**	**31.65**
75	5.67	5.66	5.00	4.51	3.95	3.40	3.24	3.17
80	4.84	4.64	4.61	4.79	4.92	4.75	4.78	4.71
85	5.40	5.24	5.22	5.11	5.11	4.93	4.97	5.03
90-93	5.44	5.71	6.01	6.31	6.70	6.77	6.99	6.97

Northern Ireland

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	5.07	4.92	5.58	5.54	4.07	3.92	2.68	2.30
15-37	**15.46**	**15.29**	**16.29**	**16.13**	**16.29**	**15.61**	**15.46**	**15.25**
40-41	3.64	3.45	2.93	2.96	2.76	2.56	2.34	2.15
45	5.83	5.28	5.80	5.88	6.17	6.32	6.81	7.26
50-52	11.18	11.00	11.05	11.45	12.23	12.50	13.10	13.16
55	2.47	2.39	2.54	2.72	2.93	3.10	3.23	3.29
60-64	5.46	5.28	5.35	5.37	5.58	5.83	5.92	6.11
65-67	2.55	3.75	3.84	3.55	3.32	3.40	3.19	3.27
70-74	**9.73**	**10.38**	**11.13**	**11.58**	**12.49**	**13.72**	**14.50**	**15.04**
75	17.26	16.57	14.15	13.73	13.02	12.15	11.81	11.33
80	7.70	7.72	7.39	7.68	7.79	7.66	7.59	7.42
85	10.52	10.54	10.28	9.62	9.35	9.16	9.24	9.33
90-93	3.13	3.45	3.67	3.78	4.00	4.07	4.11	4.09

Yorkshire & Humber

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	1.94	2.03	2.10	2.15	1.72	1.48	1.42	1.27
15-37	**22.29**	**21.58**	**23.16**	**23.01**	**22.77**	**21.41**	**20.05**	**18.98**
40-41	3.40	3.03	2.39	2.43	2.34	2.26	2.15	2.07
45	6.77	5.79	5.98	5.83	5.78	5.72	5.93	6.21
50-52	13.06	13.12	12.83	12.85	13.06	13.14	13.56	13.66
55	2.73	2.78	2.90	3.07	3.19	3.22	3.24	3.24
60-64	8.06	7.85	8.07	8.17	8.35	8.48	8.31	8.43
65-67	4.32	5.40	4.75	4.58	4.38	4.80	4.56	4.68
70-74	**15.04**	**15.13**	**15.36**	**15.58**	**16.11**	**16.97**	**17.39**	**17.61**
75	6.36	6.50	5.88	5.71	5.39	5.15	5.21	5.33
80	5.99	6.23	5.93	6.00	6.01	6.12	6.47	6.63
85	6.96	7.27	7.38	7.25	7.37	7.54	7.84	8.02
90-93	3.08	3.28	3.28	3.36	3.55	3.73	3.87	3.86

EMPLOYMENT TE

East Midlands

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	2.01	2.29	1.66	1.70	2.33	1.59	1.53	1.43
15-37	**24.81**	**23.54**	**23.71**	**24.21**	**22.72**	**21.43**	**20.25**	**19.31**
40-41	1.34	1.21	0.84	0.74	0.64	0.57	0.53	0.58
45	4.60	4.25	3.94	4.00	4.44	5.32	4.95	4.79
50-52	17.45	18.14	17.79	17.50	17.47	18.36	18.19	18.49
55	4.78	5.27	4.92	4.92	4.81	5.85	6.09	5.98
60-64	5.33	5.48	5.19	5.15	5.25	4.92	5.59	5.62
65-67	3.01	2.85	2.61	2.47	2.39	2.43	2.25	2.23
70-74	**8.28**	**9.36**	**10.09**	**10.74**	**12.07**	**11.78**	**11.91**	**12.53**
75	5.13	4.97	5.26	4.82	4.65	4.46	4.95	4.83
80	9.28	7.82	8.65	8.70	8.48	8.77	8.55	8.57
85	10.58	10.78	11.56	10.81	10.62	10.80	10.88	11.22
90-93	3.40	4.02	3.79	4.23	4.13	3.72	4.33	4.41

Eastern

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	2.44	2.62	2.03	2.13	2.67	1.85	1.76	1.56
15-37	**17.45**	**15.80**	**16.36**	**16.27**	**15.55**	**14.32**	**13.45**	**13.13**
40-41	1.05	0.96	0.76	0.63	0.58	0.58	0.53	0.60
45	4.29	3.66	4.03	3.85	4.52	4.50	4.93	4.74
50-52	18.51	18.51	18.88	19.04	19.41	20.22	19.57	20.22
55	4.93	5.18	5.16	5.15	5.11	5.91	6.02	6.15
60-64	7.07	6.90	6.54	6.72	6.44	6.57	7.17	6.90
65-67	4.85	4.35	4.03	3.62	4.11	4.04	3.94	3.59
70-74	**11.23**	**12.66**	**14.05**	**14.16**	**14.97**	**15.30**	**15.46**	**16.32**
75	5.68	5.70	5.31	4.81	4.65	5.15	4.17	4.15
80	8.90	8.78	8.20	8.51	7.97	7.48	8.63	8.26
85	9.94	10.92	10.45	10.44	9.54	9.72	9.72	9.90
90-93	3.67	3.95	4.20	4.68	4.48	4.37	4.66	4.49

Scotland

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	1.32	1.87	1.92	1.58	1.91	1.57	1.49	1.55
15-37	**15.10**	**13.67**	**13.51**	**13.65**	**13.98**	**13.02**	**12.35**	**11.39**
40-41	0.95	1.04	0.99	0.69	0.83	0.64	0.71	0.62
45	7.01	6.60	6.58	6.07	5.76	6.71	6.45	6.07
50-52	15.87	16.03	15.93	16.57	16.66	16.88	16.88	16.27
55	6.82	6.83	6.50	6.72	6.66	7.55	7.29	7.70
60-64	6.18	6.01	5.73	5.53	5.46	5.56	5.73	5.52
65-67	4.02	4.02	4.22	3.82	4.10	4.02	4.15	4.36
70-74	**10.34**	**11.17**	**11.60**	**11.22**	**11.17**	**11.82**	**11.83**	**12.94**
75	7.13	7.03	6.97	7.32	6.60	7.96	7.03	6.86
80	8.41	7.61	7.84	8.00	7.84	6.70	7.89	8.40
85	12.35	13.03	13.28	13.72	13.96	12.38	12.43	12.66
90-93	4.50	5.09	4.93	5.11	5.06	5.19	5.78	5.65

London

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	0.06	0.11	0.08	0.11	0.12	0.07	0.06	0.07
15-37	**8.87**	**8.06**	**7.79**	**7.73**	**7.51**	**6.92**	**6.74**	**6.22**
40-41	0.74	0.67	0.35	0.31	0.25	0.21	0.21	0.24
45	3.72	2.83	2.98	2.79	3.21	3.59	3.39	3.34
50-52	15.29	15.62	15.89	15.58	15.96	15.79	16.08	15.49
55	5.23	5.29	5.80	5.71	6.14	6.57	6.95	6.58
60-64	9.42	9.21	8.26	8.20	7.91	8.13	7.86	7.90
65-67	9.41	9.02	9.08	9.43	8.82	8.41	8.68	8.52
70-74	**17.44**	**18.84**	**21.82**	**21.74**	**22.27**	**23.37**	**23.22**	**25.30**
75	7.99	7.83	6.89	6.70	6.18	5.87	5.86	5.42
80	6.30	6.91	5.98	6.21	6.21	6.38	6.42	6.32
85	9.55	9.46	8.51	9.10	8.90	8.28	7.85	8.11
90-93	5.96	6.16	6.56	6.40	6.50	6.40	6.66	6.49

Northern Ireland

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	3.27	3.25	3.07	2.95	2.83	2.69	2.54	2.57
15-37	**16.10**	**14.98**	**15.20**	**15.17**	**15.24**	**14.74**	**14.16**	**13.90**
40-41	1.27	1.11	0.88	0.83	0.76	0.62	0.57	0.58
45	5.24	4.79	4.33	4.11	4.79	5.02	5.20	5.70
50-52	14.98	15.20	15.87	15.96	16.20	16.79	17.04	17.43
55	4.05	4.38	4.86	5.09	5.18	5.81	5.95	6.23
60-64	4.12	3.94	3.99	4.07	4.16	4.06	4.19	4.34
65-67	2.61	2.65	2.54	2.46	2.39	2.38	2.37	2.45
70-74	**5.26**	**5.50**	**5.66**	**5.89**	**6.21**	**6.85**	**7.52**	**8.11**
75	11.08	11.42	10.87	10.72	10.31	9.90	9.66	9.75
80	11.38	11.26	11.26	11.60	11.11	10.84	10.75	10.90
85	15.86	16.57	16.71	16.45	16.05	15.77	15.54	15.67
90-93	4.79	4.95	4.77	4.70	4.76	4.51	4.51	2.36

Yorkshire & Humber

sic sectors	1991	1993	1995	1996	1997	1998	1999	2000
	%	%	%	%	%	%	%	%
01 + 02	1.39	1.45	1.16	1.22	1.55	1.02	0.97	0.87
15-37	**20.07**	**19.40**	**19.22**	**19.71**	**18.85**	**17.26**	**16.47**	**15.63**
40-41	1.26	0.89	0.71	0.66	0.66	0.59	0.49	0.45
45	5.50	4.87	4.74	4.54	4.85	4.90	5.30	4.94
50-52	17.53	17.28	17.61	17.51	17.24	18.99	17.93	18.73
55	5.84	5.86	5.59	5.99	5.90	6.74	6.50	6.39
60-64	5.63	5.85	5.91	5.58	5.89	5.78	5.56	6.20
65-67	3.85	3.74	3.93	3.47	3.94	3.88	3.99	3.71
70-74	**9.00**	**9.34**	**10.57**	**10.46**	**11.39**	**11.17**	**11.48**	**12.33**
75	5.51	6.09	6.09	5.86	5.04	5.04	5.19	5.20
80	8.48	8.94	8.48	9.05	8.37	8.84	9.57	9.39
85	12.04	11.94	11.79	11.38	11.82	11.35	12.06	11.45
90-93	3.91	4.35	4.21	4.58	4.50	4.45	4.50	4.71

Appendix 10 Data Mapping

GVA (ONS)	ABI (ONS BREAKDOWN)		ONS (Employment)
Industry GVA data 1	Industry GVA Data 2		Industry
Agriculture, hunting, forestry & fishing	A01: Agriculture A02: Forestry	A	01 : Agriculture, hunting, etc 02 : Forestry, logging, etc
	B:Fishing	B	05 : Fishing, operation fish hatcheries/farms
Mining & quarrying or energy producing materials	CA: Mining and Quarrying or Energy Producing Materials	Ca	10 : Mining coal/lignite; extraction of peat 11 : Extraction crude petroleum/natural gas 12 : Mining of uranium and thorium ores
Other Minning & Quarrying	CB: Mining and Quarrying Except Energy Producing Materials	Cb	13 : Mining of metal ores 14 : Other mining and quarrying
Manufacturing	DA: Manufacture of Food Products; Beverage and Tobacco	Da	15 : Manuf food products and beverages 16 : Manuf tobacco products
	DB: Manufacture of Textiles and Textile Products	Db	17 : Manuf textiles 18 : Manuf apparel;dressing/dyeing fur
	DC: Manufacture of Leather and Leather Products	Dc	19 : Tanning/dressing of leather, etc
	DD: Manufacture of Wood and Wood Products	Dd	20 : Manuf wood/products/cork, etc
	DE: Manufacture of Pulp, Paper and Paper Products Publishing and Printing	De	21 : Manuf pulp, paper and paper products 22 : Publishing,printing,repro recorded media
	DF: Manufacture of Coke, Refined Petroleum and Nuclear Fuels	Df	23 : Manuf coke, refined petroleum products
	DG: Manufacture of Chemicals, Chemical Products and Man-made Fibre	Dg	24 : Manuf chemicals and chemical products
	DH: Manufacture of Rubber and Plastic Products	Dh	25 : Manuf rubber and plastic goods
	DI: Manufacture of other Non-metallic products	Di	26 : Manuf other non-metallic products
	DJ: Manufacture of Basic Metals and Fabricated Metal Products	DJ	27 : Manuf basic metals 28 : Manuf fabricated metal products, etc
	DK: Manufacture of Machinery and equipments not elsewhere classified	Dk	29 : Manuf machinery and equipment nec
	DL: Manufacture of Electrical and Optical Equipment	Dl	30 : Manuf office machinery and computers 31 : Manuf electrical machinery/apparatus nec 32 : Manuf radio, tv/communications equipment 33 : Manuf medical,precision instruments,etc
	DM: Manufacture of Transport Equipment	Dm	34 : Manuf motor vehicles,trailers,etc 35 : Manuf other transport equipment
	DN: Manufacture not elsewhere classified	Dn	36 : Manuf furniture; manufacturing nec 37 : Recycling
Electricity, Gas and Water Supply	E: Electricity, Gas and Water Supply	E	40 : Electricity,gas,steam/hot water supply 41 : Collection,purification/distri of water
Construction	F: Construction	F	45 : Construction
Wholesale and Retail Trade (including motor trade)	G: Wholesale and Retail Trade; Repair of Motor Vehicles, Motorcycles and Personal and Household Goods	G	50 : Sale,maintenance/repair motor vehicles 51 : Wholesale trade/commission trade, etc 52 : Retail trade, except of motor vehicles
Hotels & restaurants	H: Hotels and Restaurants	H	55 : Hotels and restaurants
Transport,storage and communications	I: Transport, Storage and Communication	I	60 : Land transport; transport via pipelines 61 : Water transport 62 : Air transport 63 : Supporting/auxiliary transport,etc 64 : Post and telecommunications
Financial intermediation	J: Financial Intermediation	J	65 : Financial intermediation, etc 66 : Insurance and pension funding, etc 67 : Act auxiliary financial intermediation
Real estate,renting and business activities	K: Real Estate, Renting and Business Activities	K	70 : Real estate activities 71 : Renting machinery/equipment, etc 72 : Computing and related activities 73 : Research and development 74 : Other business activities
Public adminstration & defence	L: Public Administration and Defence; Compulsory Social Security	L	75 : Public admin/defence; compulsory SS
Education	M: Education	M	80 : Education
Health & social work	N: Health and Social Work	N	85 : Health and social work
Private households with employed persons	O: Other Community, Social and Personal Service Activities	O	90 : Sewage/refuse disposal, sanitation, etc 91 : Activities membership organisations nec 92 : Recreational, cultural and sporting 93 : Other service activities
	P: Private Household with Employed Persons	P	95 : Private households with employed persons

Appendix 11 North East data Specimen

North East - ADJUSTED

STANDARD INDUSTRIAL CLASSIFICATION OF ECONOMIC ACTIVITIES FOR GROSS VALUE ADDED 1991 - 2000

North East	sic sectors	1991 GVA	1991 Deflated	1991 employ	1991 GVA PE	1993 GVA	1993 Deflated	1993 employ	1993 GVA PE	1995 GVA	1995 employ	1995 GVA PE	1996 GVA	1996 Deflated	1996 employ	1996 GVA PE
A01: Agriculture & A02: Forestry	01 + 02	167	183	6,360	28.74	182	188	7,332	25.62	199	5,986	33.24	198	191	6,422	29.72
DB: Manufacture of Textiles and Textile Products	17-18	274	299	17,439	17.15	275	284	16,761	16.93	312	16,169	19.28	328	317	14,873	21.28
DC: Manufacture of Leather and Leather Products	19	12	13	0	0.00	12	12	508	24.53	11	0	0.00	11	10	513	20.23
DD: Manufacture of Wood and Wood Products	20	89	97	4,828	20.07	101	104	4,966	20.97	136	5,059	26.89	138	133	4,760	27.97
DE: Manufacture of Pulp, Paper and Paper Products Publishing and Printing	21+22	409	447	14,974	29.85	439	474	13,165	36.01	508	13,329	38.08	500	483	13,153	36.74
DG: Manufacture of Chemicals, Chemical Products and Man-made Fibre	24	995	1,088	26,463	41.11	1,076	1,110	21,822	50.88	1,208	21,873	55.23	1,217	1,175	20,891	56.26
DH: Manufacture of Rubber and Plastic Products	25	283	310	7,155	43.28	308	317	9,389	33.91	343	11,727	29.29	373	360	12,036	29.91
DI: Manufacture of other Non-metallic products	26	156	170	6,865	24.81	155	160	6,340	25.23	203	5,545	36.58	194	187	6,140	30.52
DJ: Manufacture of Basic Metals and Fabricated Metal Products	27-28	735	803	37,168	21.61	816	842	29,968	28.11	982	30,151	32.56	943	911	33,401	27.27
DK: Manufacture of Machinery and equipments not elsewhere classified	29	612	668	20,777	32.17	590	609	19,479	31.26	650	20,185	32.18	641	619	24,588	25.22
DL: Manufacture of Electrical and Optical Equipment	30-33	532	582	16,681	34.94	596	616	14,832	41.50	711	21,304	33.39	729	704	23,045	30.55
DM: Manufacture of Transport Equipment	34-35	397	434	16,368	26.22	526	543	13,132	41.35	581	14,213	40.89	644	622	20,482	30.37
DN: Manufacture not elsewhere classified	36-37	126	138	7,645	18.04	176	182	7,550	24.09	226	9,010	25.03	232	224	8,948	25.08
Total Manufacturing	15-37	4620	5,049	176528	28.60	5090	5,255	157869	35.28	5870	168583	34.82	6772	6,542	182800	35.79
E: Electricity, Gas and Water Supply	40-41	477	522	6,794	76.80	563	581	6,065	95.73	589	7,694	76.56	608	588	5,741	102.38
F: Construction	45	1338	1,463	56,649	25.83	1,175	1,213	50,198	24.17	1,279	47,166	27.13	1,320	1,275	48,042	26.55
G: Wholesale and Retail Trade; Repair of Motor Vehicles, Motorcycles and Personal and Household Goods	50-52	2048	2,239	132,145	16.94	2,255	2,327	138,050	16.86	2,362	129,883	18.18	2,464	2,380	132,571	17.95
H: Hotels and Restaurants	55	461	504	48,071	10.48	508	524	43,614	12.02	580	43,405	13.36	631	610	48,515	12.57
I: Transport, Storage and Communication	60-64	1528	1,670	47,922	34.84	1,584	1,635	46,980	34.80	1,737	43,466	39.96	1,820	1,758	46,390	37.89
J: Financial Intermediation	65-67	658	719	23,816	30.18	785	810	22,692	35.69	743	19,887	37.36	754	728	19,789	36.86
K: Real Estate, Renting and Business Activities	70-74	2700	2,951	79,830	36.97	3,079	3,178	87,502	36.32	3,378	81,846	41.28	3,568	3,446	83,404	41.32
L: Public Administration and Defence; Compulsory Social Security	75	1325	1,448	71,937	20.13	1,554	1,603	76,677	20.91	1,513	68,426	22.11	1,481	1,430	77,027	18.57
M: Education	80	1344	1,469	85,675	17.14	1,476	1,524	75,326	20.23	1,548	78,276	19.78	1,587	1,533	70,502	21.74
N: Health and Social Work	85	1366	1,493	102,432	14.57	1,626	1,678	105,265	15.95	1,877	115,124	16.30	1,963	1,896	113,696	16.68
O: Other Community, Social and Personal Service Activities	90-93	584	639	37,737	16.92	699	722	43,730	16.50	807	42,278	19.08	861	832	42,926	19.38
Grand Total		18,616	20,347	875,914	23.23	20,578	21,236	861,300	24.66	22,482	852,018	26.39	24,026	23,209	877,795	26.44
FISIM		-282	-308			-327	-337			-368			-358	-346		
TOTAL		18,334	20,039	875,914	22.88	20,251	20,899	861,300	24.26	22,114	852,018	25.95	23,668	22,864	877,795	26.05

North East	sic sectors	1997 GVA	1997 Deflated	1997 employ	1997 GVA PE	1998 GVA	1998 Deflated	1998 employ	1998 GVA PE	1999 GVA	1999 Deflated	1999 employ	1999 GVA PE	2000 GVA	2000 Deflated	2000 employ	2000 GVA PE
A01: Agriculture & A02: Forestry	01 + 02	176	165	8,616	19.16	169	154	5,491	28.07	170	151	5,295	28.77	139	137	4,755	28.89
DB: Manufacture of Textiles and Textile Products	17-18	330	310	13,071	23.68	277	253	14,683	17.21	234	208	12,115	17.16	202	175	8,658	20.19
DC: Manufacture of Leather and Leather Products	19	12	11	453	24.46	12	11	682	16.38	11	10	385	26.30	10	9	0	0.00
DD: Manufacture of Wood and Wood Products	20	146	137	4,378	31.23	135	123	3,645	33.87	118	105	4,117	25.45	111	96	3,870	24.73
DE: Manufacture of Pulp, Paper and Paper Products Publishing and Printing	21+22	470	441	12,369	35.64	455	415	12,399	33.55	464	412	11,560	35.62	493	426	11,469	37.14
DG: Manufacture of Chemicals, Chemical Products and Man-made Fibre	24	1,170	1,097	20,199	54.33	1,138	1,038	18,375	56.49	1,102	978	16,071	60.87	1,096	947	16,173	58.54
DH: Manufacture of Rubber and Plastic Products	25	416	390	13,078	29.83	434	396	14,043	28.17	418	371	12,941	28.67	414	358	13,196	27.23
DI: Manufacture of other Non-metallic products	26	182	170	5,642	30.19	167	153	5,129	29.74	164	146	4,715	30.96	174	151	4,889	30.93
DJ: Manufacture of Basic Metals and Fabricated Metal Products	27-28	905	849	30,560	27.77	914	833	28,629	29.11	840	746	28,411	26.27	834	721	27,787	25.93
DK: Manufacture of Machinery and equipments not elsewhere classified	29	671	630	23,369	26.95	672	613	20,129	30.46	649	576	15,934	36.15	650	562	17,975	31.26
DL: Manufacture of Electrical and Optical Equipment	30-33	738	693	21,478	32.25	710	647	22,836	28.34	683	606	21,028	28.84	679	587	19,244	30.48
DM: Manufacture of Transport Equipment	34-35	722	678	16,202	41.82	745	679	17,605	38.59	738	656	17,485	37.50	725	626	16,588	37.77
DN: Manufacture not elsewhere classified	36-37	246	230	9,955	23.14	245	224	9,105	24.55	241	214	9,265	23.11	232	200	9,399	21.31
Total Manufacturing	15-37	6007	5,638	170750	33.00	5904	5,384	167196	32.20	6433	5,713	154021	37.09	5620	4,856	149162	32.59
E: Electricity, Gas and Water Supply	40-41	609	571	4,911	116.37	651	593	5,055	117.44	718	638	6,079	104.92	736	654	7,420	88.08
F: Construction	45	1,399	1,313	52,607	24.95	1,430	1,304	51,728	25.21	1,455	1,292	56,364	22.92	1,509	1,304	55,775	23.38
G: Wholesale and Retail Trade; Repair of Motor Vehicles, Motorcycles and Personal and Household Goods	50-52	2,617	2,454	137,896	17.80	2,755	2,513	151,498	16.59	2,850	2,531	158,847	15.93	2,876	2,485	156,306	15.90
H: Hotels and Restaurants	55	691	648	49,699	13.05	746	680	60,310	11.28	796	707	66,112	10.70	855	739	58,762	12.57
I: Transport, Storage and Communication	60-64	1,895	1,777	43,156	39.38	1,939	1,769	45,255	39.09	1,876	1,666	43,452	36.66	1,893	1,636	47,385	34.52
J: Financial Intermediation	65-67	751	705	18,818	37.45	852	777	20,914	37.15	811	720	20,201	35.66	867	749	20,660	36.24
K: Real Estate, Renting and Business Activities	70-74	3,842	3,604	92,001	39.17	4,188	3,820	98,767	38.66	4,383	3,892	92,308	42.16	4,638	4,007	100,352	39.93
L: Public Administration and Defence; Compulsory Social Security	75	1,438	1,349	62,664	21.53	1,421	1,296	68,330	18.96	1,403	1,246	77,847	16.01	1,479	1,278	69,195	18.47
M: Education	80	1,605	1,506	74,348	20.25	1,656	1,510	79,296	19.05	1,805	1,603	84,217	19.03	1,966	1,699	87,097	19.51
N: Health and Social Work	85	2,045	1,919	118,821	16.17	2,154	1,964	117,981	16.65	2,310	2,051	126,257	16.24	2,489	2,151	128,144	16.78
O: Other Community, Social and Personal Service Activities	90-93	952	893	44,530	20.06	1,035	944	50,157	18.82	1,085	964	52,601	18.35	1,114	963	52,508	18.33
Grand Total		24,029	22,539	880,599	25.60	24,900	22,709	921,996	24.63	26,095	23,173	945,441	24.51	26,222	22,656	937,515	24.17
FISIM		-354	-332			-439	-400			-467	-415			-588	-508		
TOTAL		23,675	22,207	880,599	25.22	24,461	22,308	921,996	24.20	25,628	22,758	945,441	24.07	25,634	22,148	937,515	23.62

Appendix 12 Proposed hypotheses

Shift Share

H1: The North East's industry mix does not explain the difference between national and regional employment change.

H1a: Manufacturing sub sectors
H1b: Total Economy

H2: The North East's industry mix does not explain the difference between national and regional output per worker.

H2a: Manufacturing sub sectors
H2b: Total Economy

Spearman Rank Correlation

H3: k sets of ranking are dependent

H3a: Manufacturing sub sectors
H3b: Total Economy

Kendall coefficient of Concordance

H4: K sets of rankings are independent

H4a: Manufacturing sub sectors
H4b: Total Economy

Coefficient of variation

H5: Comparing regions, there is no variation in the dispersion of productivity levels over time

H6a: Manufacturing sub sectors
H6b: Total Economy

H6: Comparing sectors, three is no variation in the dispersion of productivity levels over time

H7a: Manufacturing sub sectors
H7b: Total Economy

Theil Coefficient

H7: No variation of inequality within and between regions over time

H8a: Manufacturing sub sectors
H8b: Total Economy

H8: No variation of inequality within and between sectors over time.

H8a: Manufacturing sub sectors
H8b: Total Economy

Gini Coefficient

H9: Perfect equality in productivity levels amongst the North East's sectors.

H9a: Manufacturing sub sectors
H9b: Total Economy

Appendix 13 Regional Shift Share results

TE SHIFT SHARE RESULTS

NORTH EAST

	mue	pie	alpha	yi
1991	-0.54581	-1.80905	-0.03318	-2.38804
1993	-0.56363	-2.12943	0.03617	-2.65688
1995	-0.68116	-1.24565	-0.09017	-2.01698
1996	-0.60661	-1.33997	-0.05457	-2.00115
1997	-0.75841	-2.18056	-0.09043	-3.02940
1998	-0.88309	-2.43776	-0.01765	-3.33850
1999	-1.14841	-2.00380	-0.24849	-3.40069
2000	-0.88666	-2.92597	-0.14168	-3.95431

NORTH WEST

	mue	pie	alpha	yi
1991	-0.23352	-1.85748	0.10431	-1.98669
1993	-0.20613	-1.79336	0.05895	-1.94054
1995	-0.20552	-1.45138	0.05768	-1.59922
1996	-0.27899	-1.33006	0.00719	-1.60186
1997	-0.13866	-1.65304	0.05878	-1.73292
1998	-0.37572	-2.45960	-0.08372	-2.91904
1999	-0.33450	-2.78758	-0.08648	-3.20857
2000	-0.40282	-2.43617	-0.16571	-3.00470

Yorkshire & Humber

	mue	pie	alpha	yi
1991	-0.45341	-1.81382	-0.00258	-2.26981
1993	-0.55284	-2.36799	-0.00158	-2.92240
1995	-0.40418	-2.50838	0.08189	-2.83067
1996	-0.49314	-1.88027	0.02594	-2.34747
1997	-0.32134	-2.41546	0.08414	-2.65266
1998	-0.59294	-2.18196	0.05848	-2.71642
1999	-0.63624	-2.03761	0.07385	-2.59999
2000	-0.59462	-2.86513	0.14479	-3.31496

EAST MIDLANDS

	mue	pie	alpha	yi
1991	-0.32588	-1.00902	-0.23967	-1.57457
1993	-0.16736	-1.73169	-0.08105	-1.98010
1995	-0.32117	-1.82752	-0.08357	-2.23225
1996	-0.11305	-1.72341	-0.07894	-1.91540
1997	-0.11051	-2.03969	0.05628	-2.09393
1998	-0.27728	-1.70364	-0.22060	-2.20152
1999	-0.22568	-0.82491	-0.09105	-1.14163
2000	-0.27800	-1.66170	-0.07976	-2.01946

WEST MIDLANDS

	mue	pie	alpha	yi
1991	-0.06855	-2.24070	-0.05107	-2.36031
1993	-0.02355	-2.26987	0.04691	-2.24651
1995	0.18236	-2.50449	-0.17976	-2.50189
1996	0.19635	-2.88767	-0.09797	-2.78929
1997	0.26254	-2.65273	-0.20318	-2.59337
1998	0.20321	-2.74020	-0.16332	-2.70032
1999	0.14679	-2.98375	-0.17642	-3.01339
2000	0.13366	-2.53711	-0.22839	-2.63185

EAST OF ENGLAND

	mue	pie	alpha	yi
1991	0.15355	3.90172	-0.11559	3.93968
1993	0.15791	3.74971	-0.13186	3.77576
1995	0.16765	3.10014	-0.07793	3.18986
1996	0.11975	3.77415	-0.24146	3.65245
1997	0.14097	2.94394	-0.08891	2.99600
1998	0.24616	2.96094	-0.04262	3.16448
1999	0.28782	4.38060	-0.17507	4.49335
2000	0.20840	3.10941	-0.21418	3.10363

MSS SHIFT SHARE RESULTS

NORTH EAST

	mue	pie	alpha	yi
1991	1.07750	0.56231	-0.47746	1.16235
1993	0.75083	2.47624	-0.29468	2.93239
1995	1.15587	0.70429	-0.03651	1.82365
1996	1.07792	-1.94995	-0.24652	-1.11854
1997	0.83279	-0.90631	-0.17197	-0.24550
1998	0.53361	-1.60748	0.29280	-0.78106
1999	0.33015	-0.94714	0.29353	-0.32346
2000	0.36845	-1.78038	0.40509	-1.00683

NORTH WEST

	mue	pie	alpha	yi
1991	0.58912	-0.06012	0.40078	0.92978
1993	0.94299	-0.96646	0.53738	0.51391
1995	0.72351	-0.88750	0.59102	0.42703
1996	0.90024	-0.56881	0.39196	0.72340
1997	0.96704	-1.51432	0.09518	-0.45210
1998	0.42036	-1.09442	0.20631	-0.46775
1999	0.58416	-1.39799	0.24112	-0.57272
2000	0.36070	-1.86764	0.20650	-1.30043

Yorkshire & Humber

	mue	pie	alpha	yi
1991	-1.46205	-0.47121	0.49357	-1.43970
1993	-1.35753	-2.53019	0.66927	-3.21845
1995	-1.30210	-1.38364	0.56548	-2.12025
1996	-1.09225	-1.93702	0.93602	-2.09326
1997	-0.99966	-1.74420	0.86496	-1.87889
1998	-0.92332	-1.34206	0.60159	-1.66379
1999	-1.09497	-1.49362	0.42294	-2.16566
2000	-1.10471	-2.57733	0.31542	-3.36662

EAST MIDLANDS

	mue	pie	alpha	yi
1991	-2.10535	-1.00914	0.03700	-3.07750
1993	-2.66277	-1.05034	0.23430	-3.47881
1995	-2.16772	-1.86548	0.22044	-3.81275
1996	-1.81862	-2.20864	0.17353	-3.85373
1997	-1.77650	-1.35351	0.36571	-2.76430
1998	-2.23556	-1.40779	0.28702	-3.35633
1999	-2.08801	-0.67920	0.33961	-2.42760
2000	-2.00101	-2.35282	0.38163	-3.97220

WEST MIDLANDS

	mue	pie	alpha	yi
1991	-1.12142	-3.03342	0.83299	-3.32186
1993	-1.25493	-2.90661	1.18848	-2.97306
1995	-1.12304	-4.33559	0.55989	-4.89874
1996	-1.11568	-4.52461	0.88683	-4.75347
1997	-0.93476	-4.62334	0.43659	-5.12151
1998	-0.71078	-5.07726	0.63688	-5.15116
1999	-1.36490	-5.51395	0.87330	-6.00555
2000	-1.78232	-4.21337	0.67172	-5.32396

EAST OF ENGLAND

	mue	pie	alpha	yi
1991	1.14695	0.16394	-0.08546	1.22543
1993	1.42006	0.35518	0.10135	1.87660
1995	1.38521	-1.53505	0.07857	-0.07127
1996	0.96783	-0.17102	-0.30287	0.49395
1997	0.84964	-0.09332	-0.35720	0.39912
1998	1.05428	0.17575	-0.29917	0.93086
1999	0.91570	1.83901	-0.37916	2.37555
2000	0.74300	-0.90533	-0.28326	-0.44559

TE SHIFT SHARE RESULTS

LONDON

	mue	pie	alpha	yi
1991	1.51091	2.39874	-1.00912	2.90053
1993	1.86176	3.34538	-0.61462	4.59252
1995	1.44180	2.97579	-0.95236	3.46523
1996	1.54693	3.02264	-0.86426	3.70532
1997	1.44539	3.05492	-0.72528	3.77502
1998	1.83962	2.91943	-0.73507	4.02397
1999	1.56731	2.52852	-0.61233	3.48350
2000	1.93654	1.97238	-1.03290	2.87602

SOUTH EAST

	mue	pie	alpha	yi
1991	0.21458	2.94620	-0.04687	3.11391
1993	0.01443	2.98362	-0.16012	2.83793
1995	0.09778	3.48755	-0.14733	3.43799
1996	0.26663	2.64905	-0.11956	2.79612
1997	0.32316	2.78343	-0.06596	3.04063
1998	0.26095	3.75325	0.01426	4.02846
1999	0.56846	2.77750	-0.14241	3.20355
2000	0.38076	3.34096	-0.08909	3.63262

SOUTH WEST

	mue	pie	alpha	yi
1991	-0.45743	-0.08451	-0.11180	-0.65374
1993	-0.56741	-0.70090	-0.00739	-1.27571
1995	-0.44598	-0.88190	0.06793	-1.25995
1996	-0.49199	-0.74875	0.06313	-1.17761
1997	-0.56508	-1.24550	0.08868	-1.72189
1998	-0.79772	0.10692	-0.10799	-0.79878
1999	-0.75058	-0.48549	-0.03993	-1.27600
2000	-0.97438	-0.58207	-0.07075	-1.62720

WALES

	mue	pie	alpha	yi
1991	-1.01975	-0.42480	-0.05242	-1.49698
1993	-1.02007	-1.15460	-0.13902	-2.31368
1995	-0.81547	-0.62359	-0.11603	-1.55510
1996	-1.05145	-0.61952	-0.38420	-2.05517
1997	-1.11236	-0.52914	-0.18215	-1.82365
1998	-1.51977	0.26325	-0.28399	-1.54051
1999	-1.28278	-1.13539	-0.02218	-2.44035
2000	-1.25589	-1.18336	-0.12976	-2.56901

SCOTLAND

	mue	pie	alpha	yi
1991	-0.28812	-0.70571	-0.15417	-1.14800
1993	-0.23156	-0.90911	-0.19900	-1.33967
1995	-0.20114	-0.52991	-0.29067	-1.02172
1996	-0.58656	0.22267	-0.30119	-0.66508
1997	-0.69169	0.63964	-0.11686	-0.16891
1998	-0.55662	-0.39066	-0.19906	-1.14633
1999	-0.51197	-0.45835	-0.06091	-1.03123
2000	-0.61356	-1.84206	0.05436	-2.40126

NORTHERN IRELAND

	mue	pie	alpha	yi
1991	-1.46770	-2.78055	0.70380	-3.54445
1993	-1.80244	-2.29913	0.44817	-3.65339
1995	-1.90512	-1.31231	-0.22338	-3.44081
1996	-1.98515	-0.88728	-0.12817	-3.00060
1997	-2.13524	-1.08587	-0.32788	-3.54899
1998	-2.11046	-0.39730	-0.32194	-2.82970
1999	-1.97327	-0.69392	-0.28765	-2.95484
2000	-1.99601	-0.62504	-0.77011	-3.39116

MSS SHIFT SHARE RESULTS

LONDON

	mue	pie	alpha	yi
1991	1.81986	4.44560	0.78662	7.05208
1993	1.50388	6.86468	1.18140	9.54996
1995	1.41692	6.80428	1.12231	9.34351
1996	1.79779	6.76350	1.04273	9.60401
1997	0.78242	8.17555	0.84078	9.79875
1998	1.11637	8.24583	1.03936	10.40157
1999	1.58934	7.04900	1.11058	9.74892
2000	2.18631	6.00306	1.94327	10.13265

SOUTH EAST

	mue	pie	alpha	yi
1991	1.70303	0.16178	0.04146	1.90626
1993	2.28234	0.25443	0.19762	2.73439
1995	2.26688	1.06383	0.12866	3.45938
1996	1.65878	1.64100	-0.11625	3.18353
1997	1.73020	2.26174	-0.03468	3.95727
1998	1.94348	3.58006	-0.11383	5.40972
1999	2.13331	2.19086	-0.09000	4.23418
2000	2.16900	2.72616	-0.10821	4.78694

SOUTH WEST

	mue	pie	alpha	yi
1991	0.49361	-1.50072	0.02358	-0.98353
1993	0.51274	-3.09934	0.33928	-2.24732
1995	0.31208	-2.05781	0.25432	-1.49141
1996	0.20231	-1.47510	0.28614	-0.98666
1997	0.18278	-1.19943	0.32840	-0.68824
1998	0.32993	-0.44353	0.46339	0.34979
1999	0.19976	-0.47155	0.48378	0.21199
2000	0.23543	-0.23650	0.40963	0.40857

WALES

	mue	pie	alpha	yi
1991	-0.15558	2.27952	1.41386	3.53780
1993	0.03622	-0.70792	0.59000	-0.08170
1995	-0.21766	1.75343	0.23190	1.76766
1996	-0.24782	0.75615	0.45136	0.95970
1997	-0.20706	1.02068	0.07406	0.88768
1998	-0.10227	1.47821	0.32391	1.69985
1999	-0.06164	-0.34336	0.04240	-0.36260
2000	-0.21939	-0.04091	0.01184	-0.24847

SCOTLAND

	mue	pie	alpha	yi
1991	-0.28164	0.04815	-0.16179	-0.39528
1993	-0.61645	1.13017	0.28134	0.79506
1995	-0.62169	3.86787	0.93175	4.17794
1996	-0.69774	4.31026	1.10085	4.71338
1997	-0.33760	3.50736	1.19006	4.35982
1998	-0.14733	2.29894	0.93635	3.08795
1999	0.06460	2.65295	0.58099	3.29853
2000	0.51639	0.92582	0.14839	1.59060

NORTHERN IRELAND

	mue	pie	alpha	yi
1991	-2.25408	-4.03293	0.08830	-6.19871
1993	-2.48557	-3.58200	-0.15685	-6.22442
1995	-3.10192	-2.57483	-0.52387	-6.20062
1996	-2.55993	-2.22566	-0.73975	-5.52535
1997	-2.20791	-3.55924	-0.70550	-6.47265
1998	-2.67547	-3.31021	-0.40369	-6.38937
1999	-2.39036	-2.87554	-0.48693	-5.75283
2000	-2.07206	-3.86039	-0.45373	-6.38618

Source: Author's calculations

Appendix 14 Regional Coefficient of variation results

Manufacturing sub sectors

OPE	1991	1993	1995	1996	1997	1998	1999	2000
NE	0.43854	0.30308	0.41186	0.29776	0.26709	0.32546	0.33389	0.45226
NW	0.38224	0.39338	0.40304	0.38596	0.28639	0.28897	0.28997	0.45462
Y&H	0.28650	0.23831	0.34877	0.33261	0.24411	0.21914	0.18919	0.18957
EM	0.30885	0.32105	0.22379	0.23466	0.25559	0.26101	0.26372	0.27433
WM	0.24816	0.28112	0.21633	0.22416	0.23261	0.20359	0.22308	0.22436
E	0.34838	0.38093	0.29954	0.33698	0.26470	0.19880	0.22423	0.20027
L	0.24172	0.33485	0.35550	0.29225	0.34549	0.28421	0.30257	0.30315
SE	0.42823	0.51936	0.41794	0.53891	0.38080	0.34057	0.34007	0.34795
SW	0.22599	0.27321	0.23269	0.24321	0.27716	0.18379	0.21517	0.18363
W	0.47148	0.35118	0.39093	0.38539	0.33628	0.33284	0.28887	0.38054
S	0.32473	0.28237	0.38109	0.38486	0.33470	0.29483	0.31151	0.25412
NI	0.37562	0.30791	0.38027	0.40825	0.35466	0.37135	0.41578	0.39388

Total Economy

OPE	1991	1993	1995	1996	1997	1998	1999	2000
NE	0.54105	0.54603	0.48540	0.56599	0.62397	0.65346	0.60397	0.57292
NW	0.47415	0.48924	0.49823	0.51559	0.48480	0.61713	0.57168	0.59985
Y&H	0.40754	0.47822	0.49455	0.53189	0.48134	0.51222	0.56831	0.58673
EM	0.42439	0.44175	0.47970	0.54675	0.58285	0.57392	0.55832	0.47899
WM	0.45154	0.45633	0.44450	0.57978	0.49578	0.53097	0.65023	0.45032
E	0.46330	0.50569	0.49754	0.55452	0.53287	0.48939	0.50804	0.43337
L	0.41648	0.49101	0.63244	0.65409	0.73092	0.75208	0.75550	0.63472
SE	0.46892	0.56551	0.56554	0.60043	0.52070	0.53852	0.61911	0.56522
SW	0.41226	0.47994	0.46367	0.53304	0.50209	0.54686	0.59586	0.53267
W	0.55691	0.45949	0.47809	0.58241	0.55384	0.63012	0.58074	0.52510
S	0.45663	0.44178	0.49090	0.69955	0.59693	0.70013	0.60619	0.64326
NI	0.46869	0.46441	0.50223	0.53992	0.52406	0.58945	0.60004	0.55022

Source: Author's calculations

Appendix 15 Sector Coefficient of variation result

Manufacturing sub sectors

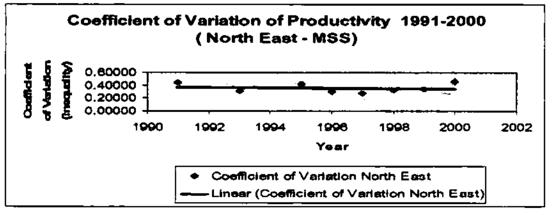
OPE	1991	1993	1995	1996	1997	1998	1999	2000
17-18	0.09818	0.11015	0.09609	0.08856	0.11553	0.16573	0.16906	0.18023
19	0.60778	0.15090	0.33872	0.21417	0.37811	0.23585	0.20712	0.54059
20	0.26652	0.23255	0.27644	0.17885	0.18270	0.19467	0.13496	0.14944
21+22	0.10109	0.13723	0.13358	0.12812	0.12615	0.13861	0.12838	0.14287
24	0.16153	0.21559	0.21267	0.22454	0.18765	0.19708	0.18587	0.18927
25	0.16905	0.15896	0.12310	0.10201	0.09150	0.06369	0.06909	0.06680
26	0.16165	0.10222	0.13241	0.12980	0.13953	0.12744	0.12892	0.15025
27-28	0.20016	0.16847	0.15602	0.16022	0.11498	0.10700	0.11057	0.09786
29	0.20917	0.18027	0.06155	0.10756	0.07932	0.10344	0.10650	0.10941
30-33	0.13089	0.16494	0.18839	0.20821	0.17165	0.15585	0.12663	0.10758
34-35	0.16083	0.19758	0.19033	0.20125	0.18884	0.13885	0.11988	0.11326
36-37	0.40887	0.36428	0.36142	0.30923	0.28419	0.23726	0.21391	0.24761

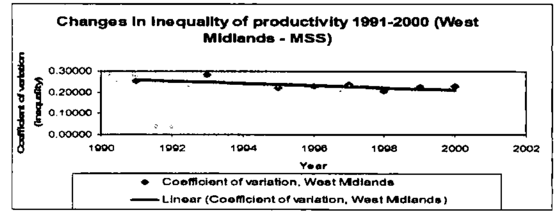
Total Economy

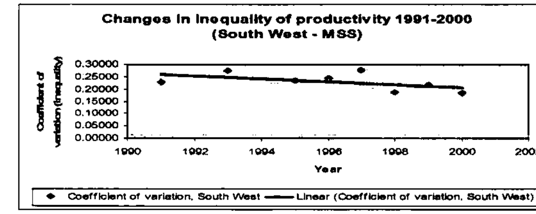
OPE	1991	1993	1995	1996	1997	1998	1999	2000
01 + 02	0.15352	0.18631	0.22382	0.28165	0.33378	0.31632	0.32941	0.29929
15-37	0.12149	0.12996	0.12527	0.12584	0.12569	0.14175	0.14039	0.14094
40-41	0.09483	0.09931	0.18096	0.15424	0.18353	0.16325	0.12988	0.15655
45	0.24447	0.25829	0.18362	0.18819	0.15309	0.17825	0.16927	0.17175
50-52	0.08623	0.09944	0.08148	0.08421	0.07686	0.09236	0.09599	0.09194
55	0.14780	0.15348	0.12252	0.14292	0.11651	0.13035	0.11882	0.11339
60-64	0.09631	0.11917	0.12182	0.12100	0.12451	0.09937	0.08806	0.10621
65-67	0.21767	0.16992	0.17057	0.19376	0.15632	0.14707	0.17043	0.18868
70-74	0.09424	0.09503	0.09094	0.09668	0.09792	0.10947	0.08848	0.10345
75	0.23051	0.19814	0.20874	0.23042	0.20568	0.23689	0.27993	0.24676
80	0.13211	0.11858	0.13043	0.13831	0.13456	0.12632	0.09391	0.09200
85	0.06048	0.05519	0.07103	0.06584	0.07230	0.07063	0.08018	0.06693
90-93	0.17710	0.19584	0.14763	0.15897	0.15650	0.15329	0.15493	0.25658
TOTAL	0.09592	0.10190	0.08809	0.08645	0.08959	0.09941	0.10180	0.09923

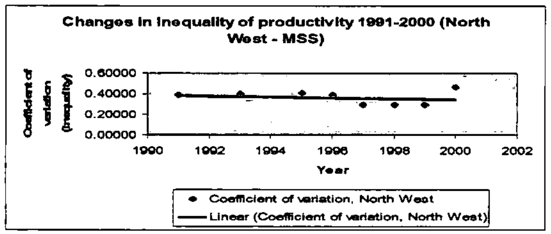
Source: Author's calculations

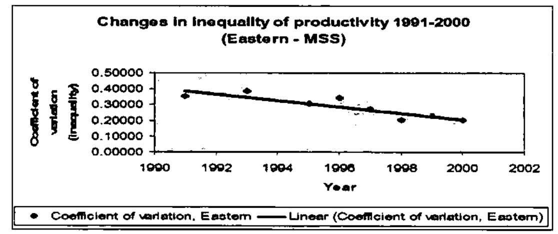
Appendix 16 Regional Coefficient of variation Figures illustrated with the best fit line

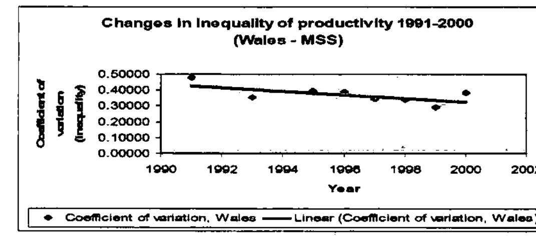


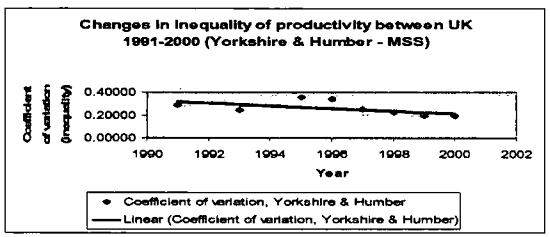


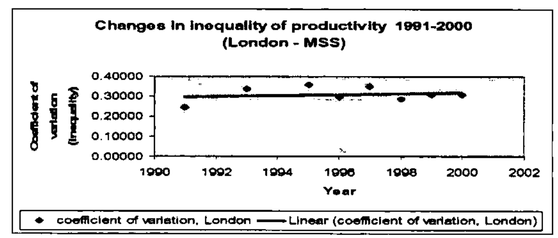


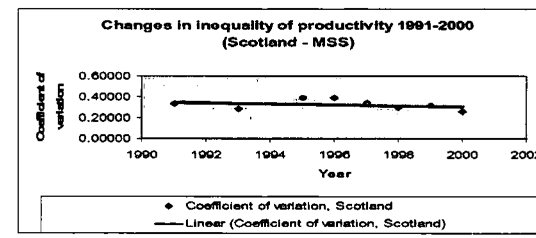


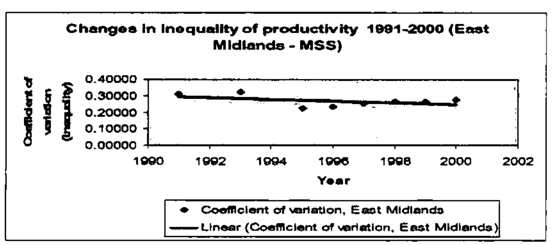


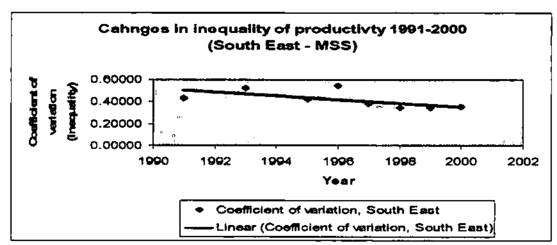


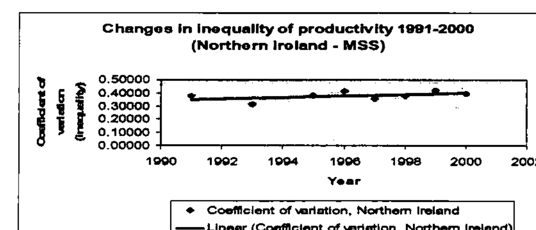


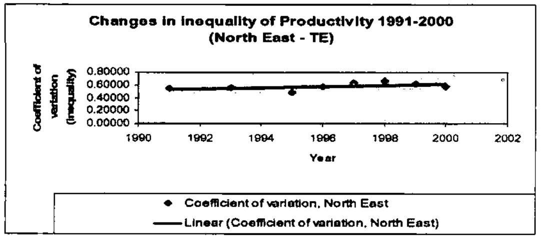


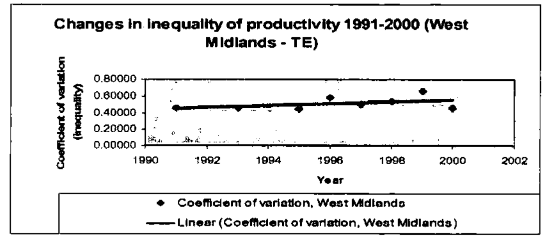


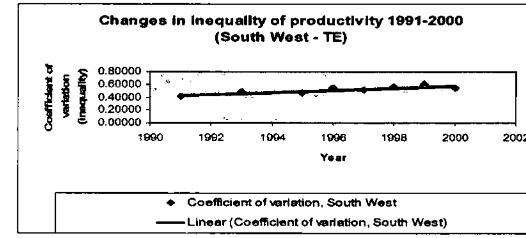


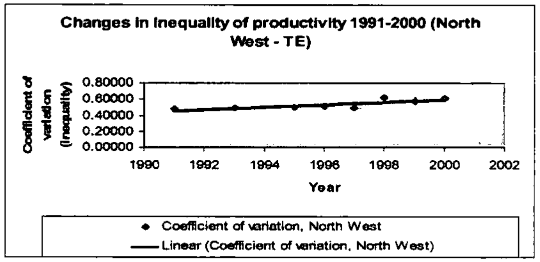


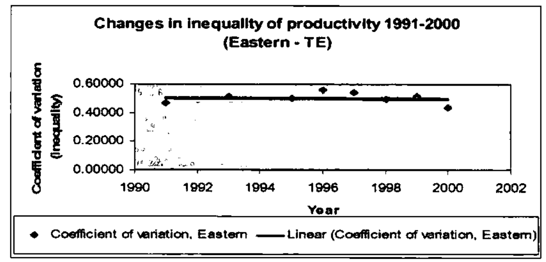


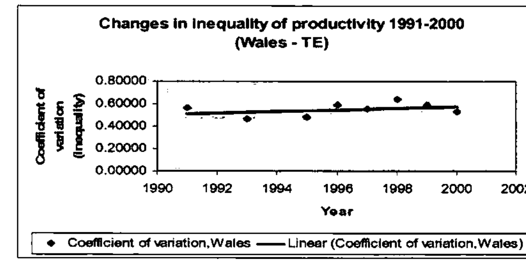


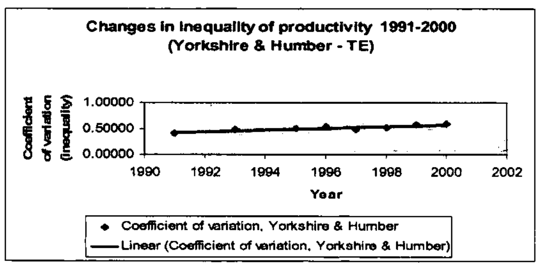


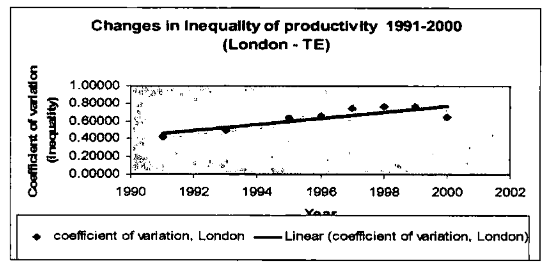


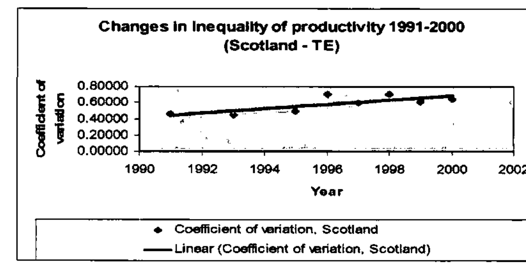


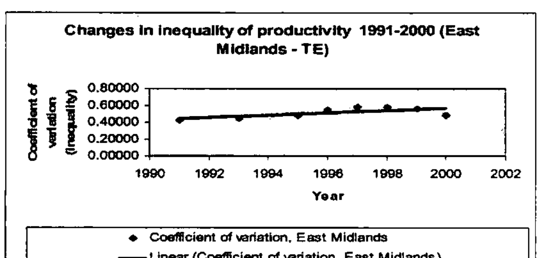


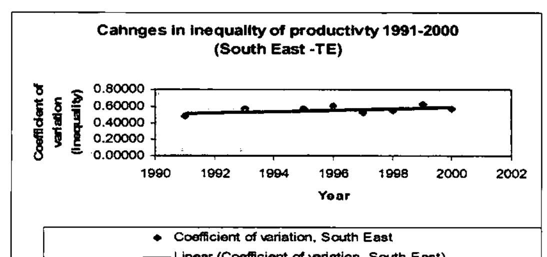


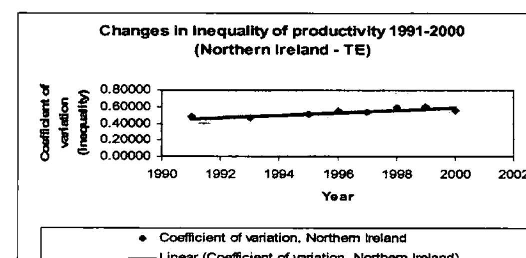






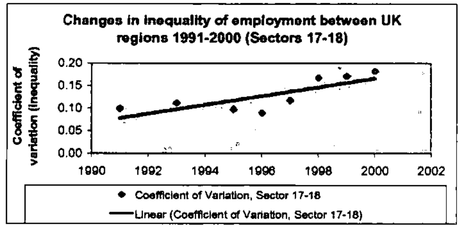


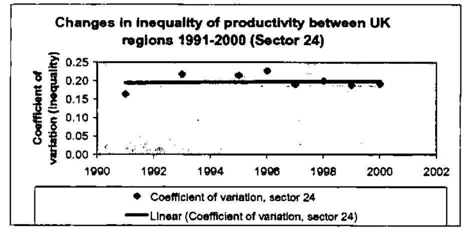


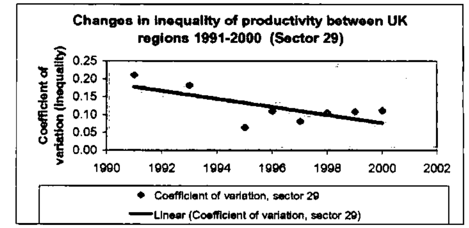


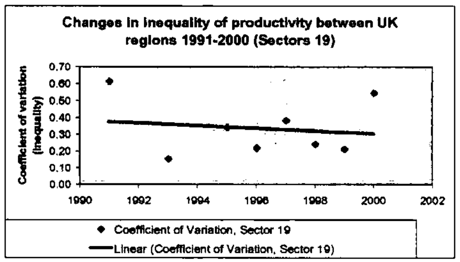
Source: Author's calculations

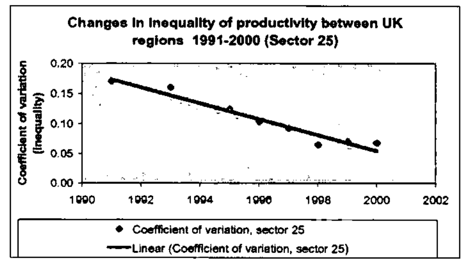
Appendix 17 Sectoral Coefficient of variation Figures illustrated with the best fit line

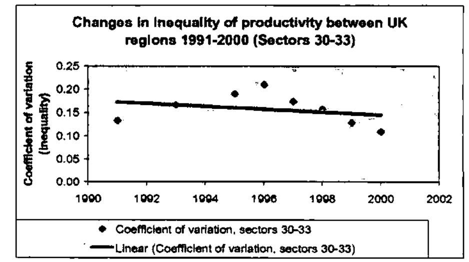


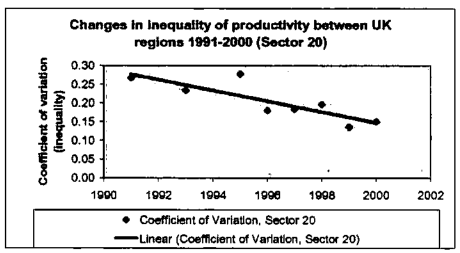


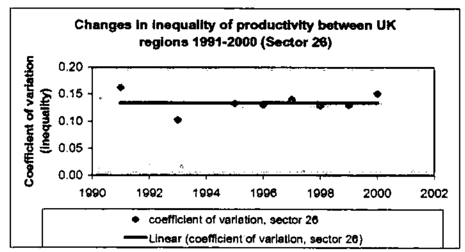


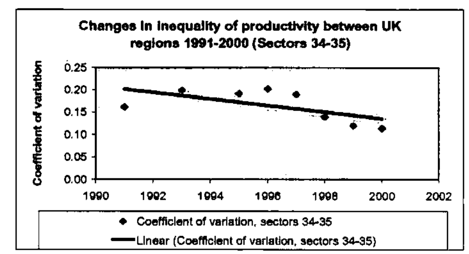


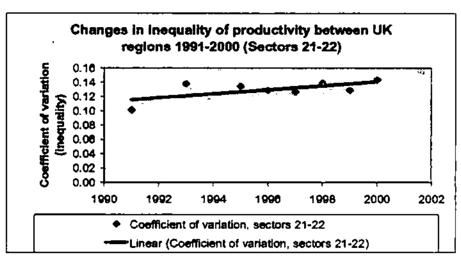


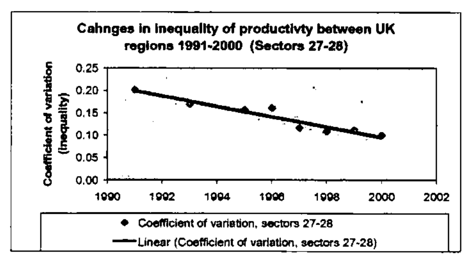


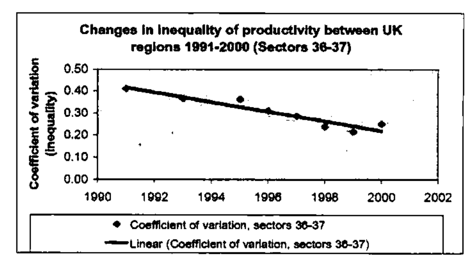


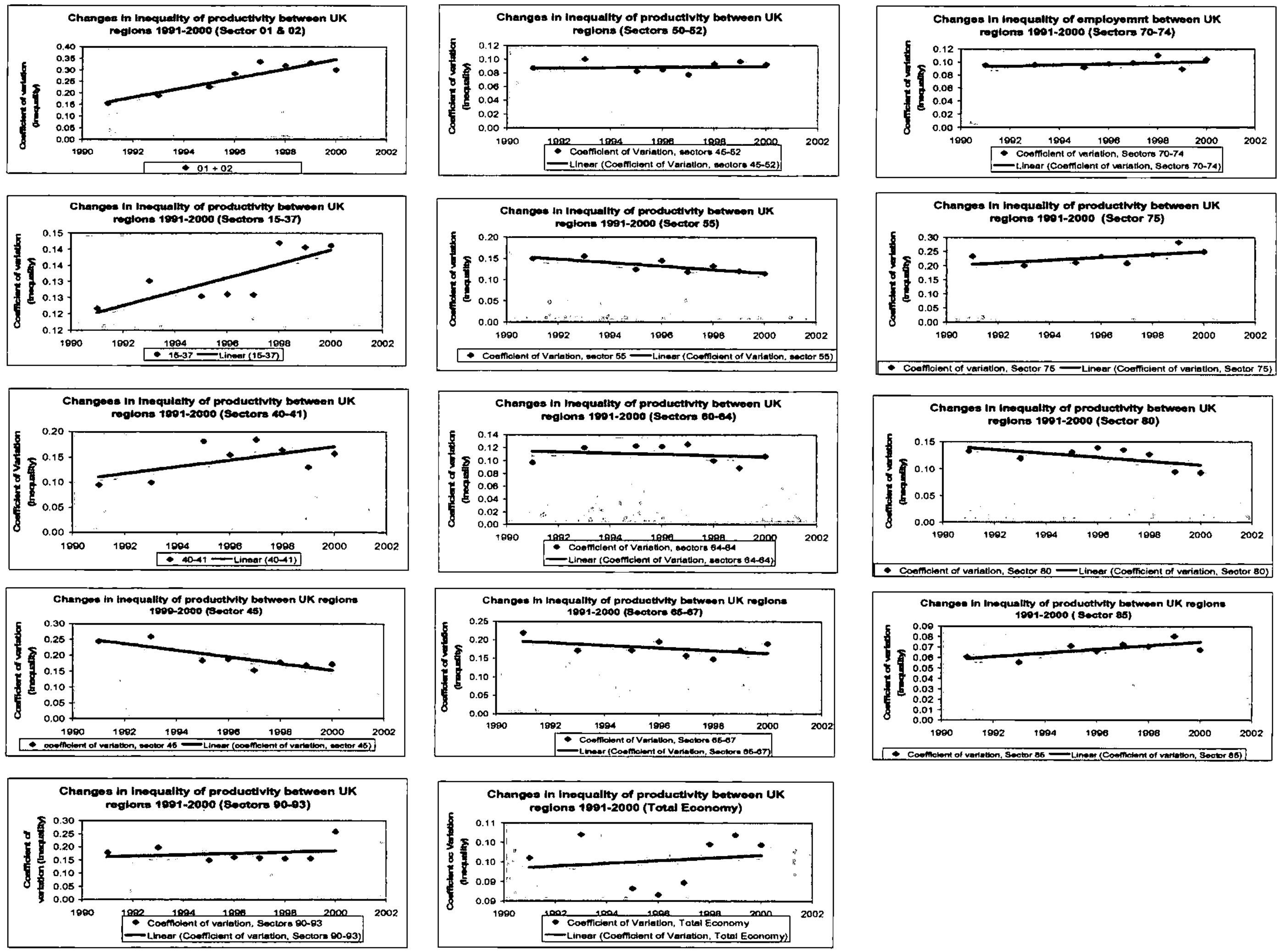












Source: Author's calculations

Appendix 18 *t*-Test Results

Table a: *t*-Test Regional Results for Manufacturing Sub Sectors

OPW MSS	
E	-4.6698
W	-2.243
WM	-2.0698
SE	-1.9941
Y&H	-1.7072
SW	-1.4609
EM	-1.2963
S	-0.7856
NW	-0.559
NE	-0.2277
L	0.4998
NI	1.4156

Source: Author's calculations

Table b: *t*-Test Regional Results for the Total Economy

OPW (TE-24)		OPW (TE-13)	
E	-0.1828	NE	1.2861
W	1.0386	WM	1.5895
WM	1.262	E	1.7247
SE	1.6336	W	1.8926
NE	1.6631	EM	2.4238
EM	2.2023	NW	3.4549
S	2.959	S	3.5487
NW	3.3104	L	4.1339
L	3.874	NI	4.1438
SW	4.188	SE	5.5076
NI	4.3195	SW	6.5131
Y&H	5.0765	Y&H	7.0016

Source: Author's calculations

Table c: *t*-Test Results for Manufacturing Sub Sectors

Rubber & plastic products	25	-10.1942
Basic metals	27-28	-8.1064
Other manufacturing	36-37	-7.356
Wood & wood products	20	-3.8623
Other metals	29	-2.2864
Transport equipment	34-35	-1.9251
Electronic & optical	30-33	-0.7145
Non-metallic mineral products	19	-0.3715
Leather	26	0.0053
Chemical & man-made fibres	24	0.1855
Paper, printing & publishing	21-22	2.1252
Textile & clothing	17-18	3.1645
Total Manufacturing	15-37	3.1955

Source: Author's calculations

Table d: *t*-Test Results for the Total Economy

Construction	45	-3.7621
Hotels & restaurants	55	-3.341
Education	80	-1.8192
Financial intermediation	65-67	-1.3351
Transport, storage and communications	60-64	-0.4909
Wholesale & retail trade	50-52	0.2688
Total Economy	TOTAL	0.4053
Private households with employed persons	90-93	0.5099
Real estate, renting and business activities	70-74	0.9475
Public administration & defence	75	1.7011
Electricity, gas and water supply	40-41	1.7783
Health & social work	85	2.44
Manufacturing	15-37	3.1955
Agriculture, hunting & forestry	01-02	5.3493

Source: Author's calculations

Appendix 19 Theil Calculation
G is a Sector

Inequality between and within regions and sectors: Theil

1991

g = sector

1991	NE	NW	YH	EM	WM	E	L	SE	SW	W	S	NI	Ave		M/Mg	ln	*ng
01 + 02	28.73851	34.11998	32.72011	33.95897	33.71156	33.19637	35.83222	23.52004	30.05707	26.30012	44.32603	34.20954	**32.55754**		0.89596	-0.10986	-1.42824
15-37	28.60410	28.29756	25.92808	24.29028	24.04592	28.59321	34.41986	29.27404	26.38425	31.08900	26.97250	21.16907	**27.42232**		1.06374	0.06179	0.80323
40-41	76.79872	69.89653	63.04357	63.07479	69.30503	70.13301	83.85767	67.35737	65.02351	79.53467	76.42020	63.32099	**70.64717**		0.41290	-0.88455	-11.49920
45	25.82514	29.50607	28.74000	35.99163	29.47543	50.91031	36.32330	44.31564	43.95039	30.63590	24.92667	24.57979	**33.76502**		0.86391	-0.14628	-1.90165
50-52	16.94167	17.29136	17.38427	18.48881	17.71101	19.91617	21.78691	19.63498	17.22514	16.40961	17.25905	16.45734	**18.04219**		1.61677	0.48043	6.24561
55	10.47837	14.25595	10.91929	12.39029	11.76628	12.99909	17.55114	13.31785	11.25389	10.84348	12.23197	13.46364	**12.62260**		2.31094	0.83766	10.88952
60-64	34.84461	32.92811	33.43549	32.92494	31.61610	40.46658	34.14045	40.27293	31.86933	30.78732	34.34461	29.21876	**33.90410**		0.86037	-0.15039	-1.95509
65-67	30.18164	26.23503	26.21676	28.99112	26.97000	48.43624	31.71039	34.41411	24.64871	28.09544	29.65160	21.58220	**29.76110**		0.98014	-0.02006	-0.26075
70-74	36.96545	36.63050	39.00270	43.56383	38.91977	48.14541	39.76972	48.02805	44.19566	44.58988	37.59743	40.82192	**41.51919**		0.70257	-0.35301	-4.58915
75	20.12911	18.74651	26.98328	26.14172	22.26127	33.77444	20.21364	36.50764	33.51095	20.76609	27.40535	34.36828	**26.73402**		1.09112	0.08721	1.13369
80	17.14379	17.82284	16.47889	13.62563	16.68258	16.16750	21.89852	15.88154	16.25098	18.68132	21.07026	14.92262	**17.21887**		1.69408	0.52714	6.85280
85	14.57351	13.66372	13.48508	13.89601	14.08081	15.76335	16.11519	15.92253	13.81419	14.93428	15.33225	14.62636	**14.68394**		1.98653	0.68639	8.92307
90-93	16.91868	17.78717	18.41956	20.77793	18.84482	26.49874	26.00692	25.30169	19.97451	19.24761	19.79661	14.42463	**20.33324**		1.43460	0.36089	4.69154
Ave	**27.54948**	**27.47549**	**27.13516**	**28.31661**	**27.33774**	**34.23080**	**32.27892**	**31.82680**	**29.08912**	**28.60882**	**29.79496**	**26.39732**	**29.17010**				
																Sum	17.90536

	ln(Mg/ygi)	ln(Mg/ygi)	ln(Mg/ygi)	ln(Mg/ygi)	ln(Mg/ygi)	ln(Mg/ygi)	ln(Mg/ygi)	ln(Mg/ygi)	ln(Mg/ygi)	ln(Mg/ygi)	ln(Mg/ygi)	ln(Mg/ygi)	ln(Mg/ygi)	IW			%
															IB	0.1243428	91.72616
01 + 02	0.12477	-0.04687	-0.00498	-0.04214	-0.03483	-0.01943	-0.09584	0.32516	0.07991	0.21344	-0.30856	-0.04950	0.14112	0.00090			0.66730
15-37	-0.04219	-0.03142	0.05603	0.12128	0.13139	-0.04181	-0.22728	-0.06534	0.03859	-0.12550	0.01654	0.25882	0.08911	0.00057			0.42138
40-41	-0.08349	0.01068	0.11387	0.11338	0.01918	0.00730	-0.17142	0.04769	0.08295	-0.11849	-0.07855	0.10948	0.05258	0.00034			0.24862
45	0.26808	0.13483	0.16114	-0.06386	0.13587	-0.41064	-0.07303	-0.27191	-0.26364	0.09725	0.30349	0.31750	0.33507	0.00215			1.58446
50-52	0.06294	0.04251	0.03715	-0.02445	0.01853	-0.09882	-0.18860	-0.08460	0.04634	0.09485	0.04438	0.09194	0.04216	0.00027			0.19935
55	0.18618	-0.12169	0.14496	0.01858	0.07025	-0.02939	-0.32963	-0.05362	0.11478	0.15193	0.03144	-0.06450	0.11927	0.00076			0.56401
60-64	-0.02736	0.02921	0.01392	0.02931	0.06987	-0.17694	-0.00695	-0.17214	0.06189	0.09643	-0.01291	0.14873	0.05305	0.00034			0.25086
65-67	-0.01403	0.12611	0.12680	0.02621	0.09848	-0.48705	-0.06344	-0.14526	0.18848	0.05760	0.00369	0.32133	0.23891	0.00153			1.12974
70-74	0.11617	0.12527	0.06252	-0.04807	0.06465	-0.14807	0.04305	-0.14563	-0.06247	-0.07135	0.09922	0.01694	0.05224	0.00033			0.24703
75	0.28377	0.35493	-0.00928	0.02240	0.18309	-0.23377	0.27958	-0.31158	-0.22594	0.25262	-0.02480	-0.25120	0.31982	0.00205			1.51236
80	0.00437	-0.03448	0.04393	0.23405	0.03164	0.06300	-0.24041	0.08085	0.05785	-0.08152	-0.20186	0.14313	0.10056	0.00064			0.47553
85	0.00755	0.07201	0.08517	0.05515	0.04194	-0.07093	-0.09301	-0.08098	0.06106	-0.01690	-0.04320	0.00393	0.02178	0.00014			0.10299
90-93	0.18384	0.13378	0.09884	-0.02163	0.07602	-0.26484	-0.24611	-0.21861	0.01780	0.05487	0.02675	0.34332	0.18402	0.00118			0.87020
														0.01122	Total IW	IB + IW	0.13556

Source: Author's calculations

G is a Region

g = region

Sector	NE	NW	YH	EM	WM	E	L	SE	SW	W	S	NI	Ave
01 + 02	28.73851	34.11998	32.72011	33.95897	33.71156	33.19637	35.83222	23.52004	30.05707	26.30012	44.32603	34.20954	32.55754
15-37	28.60410	28.29756	25.92808	24.29028	24.04592	28.59321	34.41986	29.27404	26.38425	31.08900	26.97250	21.16907	27.42232
40-41	76.79872	69.89653	63.04357	63.07479	69.30503	70.13301	83.85767	67.35737	65.02351	79.53467	76.42020	63.32099	70.64717
45	25.82514	29.50607	28.74000	35.99163	29.47543	50.91031	36.32330	44.31564	43.95039	30.63590	24.92667	24.57979	33.76502
50-52	16.94167	17.29136	17.38427	18.48881	17.71101	19.91617	21.78691	19.63498	17.22514	16.40961	17.25905	16.45734	18.04219
55	10.47837	14.25595	10.91929	12.39029	11.76628	12.99909	17.55114	13.31785	11.25389	10.84348	12.23197	13.46364	12.62260
60-64	34.84461	32.92811	33.43549	32.92494	31.61610	40.46658	34.14045	40.27293	31.86933	30.78732	34.34461	29.21876	33.90410
65-67	30.18164	26.23503	26.21676	28.99112	26.97000	48.43624	31.71039	34.41411	24.64871	28.09544	29.65160	21.58220	29.76110
70-74	36.96545	36.63050	39.00270	43.56383	38.91977	48.14541	39.76972	48.02805	44.19566	44.58988	37.59743	40.82192	41.51919
75	20.12911	18.74651	26.98328	26.14172	22.26127	33.77444	20.21364	36.50764	33.51095	20.76609	27.40535	34.36828	26.73402
80	17.14379	17.82284	16.47889	13.62563	16.68258	16.16750	21.89852	15.88154	16.25098	18.68132	21.07026	14.92262	17.21887
85	14.57351	13.66372	13.48508	13.89601	14.08081	15.76335	16.11519	15.92253	13.81419	14.93428	15.33225	14.62636	14.68394
90-93	16.91868	17.78717	18.41956	20.77793	18.84482	26.49874	26.00692	25.30169	19.97451	19.24761	19.79661	14.42463	20.33324
Ave	27.54948	27.47549	27.13516	28.31661	27.33774	34.23080	32.27892	31.82680	29.08912	28.60882	29.79496	26.39732	29.17010
ln(M/Mg)	0.05716	0.05985	0.07231	0.02970	0.06488	-0.15998	-0.10127	-0.08716	0.00278	0.01943	-0.02120	0.09988	

	NE ln(Mg/ygi)	NW ln(Mg/ygi)	YH ln(Mg/ygi)	EM ln(Mg/ygi)	WM ln(Mg/ygi)	E ln(Mg/ygi)	L ln(Mg/ygi)	SE ln(Mg/ygi)	SW ln(Mg/ygi)	W ln(Mg/ygi)	S ln(Mg/ygi)	NI ln(Mg/ygi)
	-0.04225	-0.21659	-0.18716	-0.18170	-0.20957	0.03069	-0.10443	0.30246	-0.03273	0.08414	-0.39723	-0.25924
	-0.03757	-0.02948	0.04550	0.15337	0.09952	0.22072	-0.06422	0.08361	0.09760	-0.08314	0.09952	0.22072
	-1.02520	-0.93372	-0.84300	-0.80087	-0.94191	-0.87495	-0.95471	-0.74970	-0.80438	-1.02248	-0.94191	-0.87495
	0.06464	-0.07130	-0.05746	-0.23984	0.17840	0.07134	-0.11805	-0.33103	-0.41270	-0.06846	0.17840	0.07134
	0.48621	0.46309	0.44526	0.42628	0.54600	0.47249	0.39310	0.48300	0.52399	0.55585	0.54600	0.47249
	0.96667	0.65612	0.91030	0.82654	0.89029	0.67327	0.60930	0.87120	0.94965	0.97015	0.89029	0.67327
	-0.23491	-0.18103	-0.20879	-0.15078	-0.14211	-0.10155	-0.05607	-0.23537	-0.09128	-0.07339	-0.14211	-0.10155
	-0.09125	0.04620	0.03443	-0.02354	0.00482	0.20139	0.01777	-0.07816	0.16564	0.01811	0.00482	0.20139
	-0.29400	-0.28759	-0.36280	-0.43078	-0.23260	-0.43596	-0.20869	-0.41148	-0.41826	-0.44379	-0.23260	-0.43596
	0.31382	0.38229	0.00561	0.07992	0.08360	-0.26387	0.46806	-0.13721	-0.14151	0.32039	0.08360	-0.26387
	0.47435	0.43281	0.49875	0.73150	0.34648	0.57038	0.38800	0.69515	0.58221	0.42619	0.34648	0.57038
	0.63678	0.69855	0.69925	0.71185	0.66438	0.59044	0.69465	0.69257	0.74467	0.65006	0.66438	0.59044
	0.48757	0.43482	0.38742	0.30956	0.40883	0.60433	0.21605	0.22944	0.37591	0.39633	0.40883	0.60433
	1.70483	1.39416	1.36732	1.41149	1.69614	1.75871	1.28076	1.41447	1.53880	1.72996	1.50848	1.46879
	0.01093	0.00894	0.00876	0.00905	0.01087	0.01127	0.00821	0.00907	0.00986	0.01109	0.00967	0.00942
ln(M/Mg)*	0.68593	0.71820	0.86777	0.35635	0.77851	-1.91978	-1.21524	-1.04597	0.03336	0.23315	-0.25434	1.19858

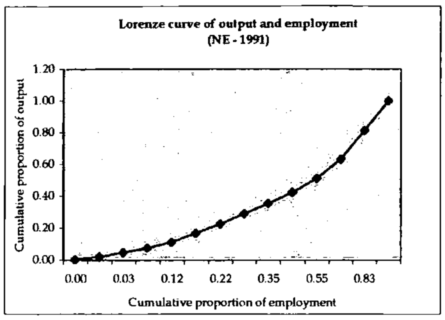
	IW	%
NE	0.01093	9.11166
NW	0.00894	7.45124
YH	0.00876	7.30780
EM	0.00905	7.54387
WM	0.01087	9.06521
E	0.01127	9.39964
L	0.00821	6.84517
SE	0.00907	7.55981
SW	0.00986	8.22429
W	0.01109	9.24598
S	0.00967	8.06224
NI	0.00942	7.85009
IW	0.11714	97.66700
IB	0.00280	2.33300
IB + IW	0.11994	100

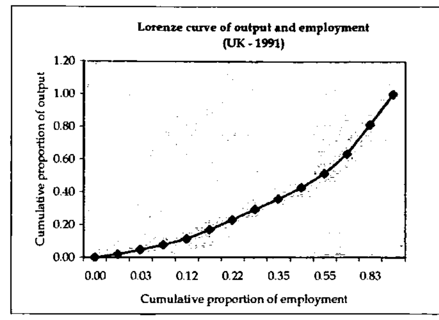
Sum	IB
0.43652	0.00280
	2.33300 %

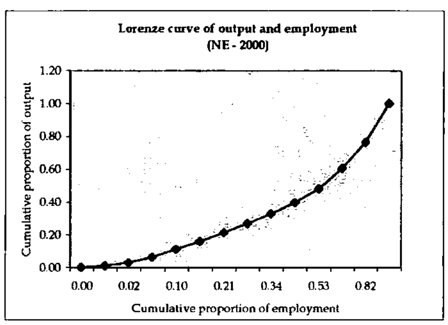
Source: Author's calculations

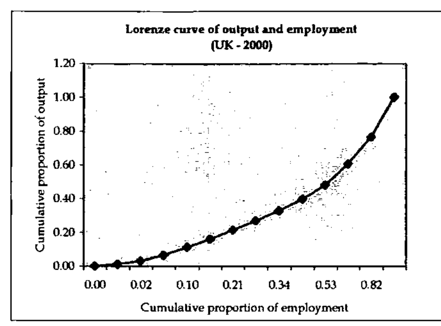
Appendix 20 Gini Coefficient the Lorenz Curve (NE)

Total Economy

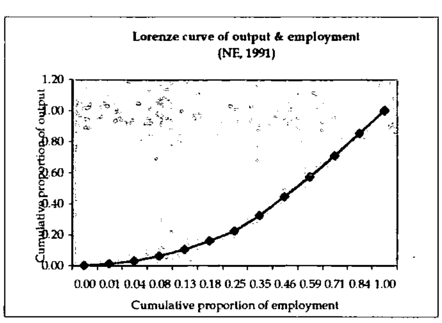


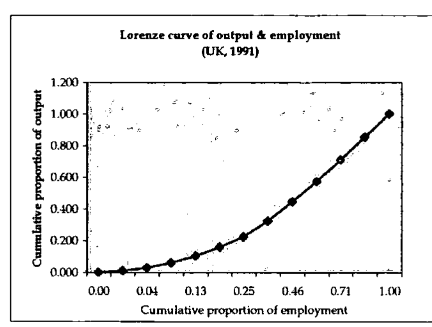


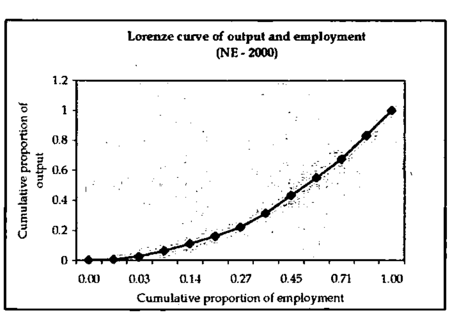


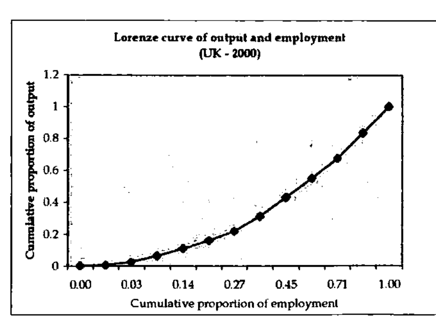


Manufacturing sub sectors









Regional Gini Coefficient Results

Manufacturing Sub Sectors

MSS	NE	NW	Y&H	EM	WM	E of E	L	SE	SW	W	S	NI	UK
1991	0.38864	0.41393	0.38640	0.32543	0.47572	0.37979	0.59539	0.43372	0.34373	0.50950	0.29921	0.45239	**0.31851**
1993	0.38036	0.38352	0.37546	0.33060	0.50320	0.35563	0.64013	0.45875	0.33980	0.46403	0.33852	0.44292	**0.32884**
1995	0.36751	0.36981	0.38247	0.33219	0.46105	0.36424	0.65262	0.48568	0.35250	0.43703	0.43509	0.40911	**0.31687**
1996	0.35260	0.35615	0.37835	0.32286	0.46704	0.35726	0.66088	0.48377	0.34665	0.41535	0.42966	0.40087	**0.31111**
1997	0.34029	0.33404	0.37971	0.31874	0.44769	0.35368	0.65813	0.46922	0.36027	0.40807	0.45975	0.39611	**0.30306**
1998	0.34732	0.33874	0.37199	0.34328	0.45562	0.34383	0.67684	0.46447	0.37319	0.42493	0.47047	0.37267	**0.31196**
1999	0.36104	0.36445	0.38488	0.31310	0.46078	0.33944	0.69928	0.48023	0.37920	0.40131	0.48835	0.36991	**0.31980**
2000	0.35841	0.37179	0.36550	0.29348	0.44714	0.33927	0.71168	0.49199	0.38562	0.37886	0.49285	0.34608	**0.32422**

Total Economy

TE	NE	NW	Y&H	EM	WM	E of E	L	SE	SW	W	S	NI	UK
1991	0.38859	0.37881	0.35952	0.41550	0.46258	0.33337	0.37980	0.36070	0.31771	0.36752	0.28583	0.26598	**0.33346**
1993	0.37086	0.35857	0.34508	0.40505	0.42504	0.33337	0.40727	0.36048	0.30513	0.35899	0.29096	0.25938	**0.32565**
1995	0.39283	0.36741	0.35816	0.41586	0.45406	0.33901	0.43675	0.35740	0.31404	0.37629	0.29983	0.23816	**0.33055**
1996	0.42299	0.35750	0.36210	0.42388	0.44372	0.34051	0.43901	0.36830	0.31798	0.37434	0.29385	0.23005	**0.33274**
1997	0.38719	0.36624	0.36569	0.42206	0.44778	0.36647	0.45152	0.38319	0.33711	0.37893	0.30320	0.23852	**0.34850**
1998	0.36906	0.36275	0.35964	0.40123	0.41373	0.38419	0.48356	0.41027	0.35466	0.34436	0.31777	0.24625	**0.36760**
1999	0.37347	0.35583	0.34793	0.39028	0.39921	0.38343	0.48470	0.40435	0.36537	0.34535	0.32698	0.26910	**0.37134**
2000	0.34485	0.35653	0.34968	0.37022	0.38237	0.38064	0.49963	0.41265	0.37149	0.32980	0.30928	0.26777	**0.36990**

Source: Author's calculations