SECTORAL PRODUCTIVITY DIFFERENCES ACROSS THE UK

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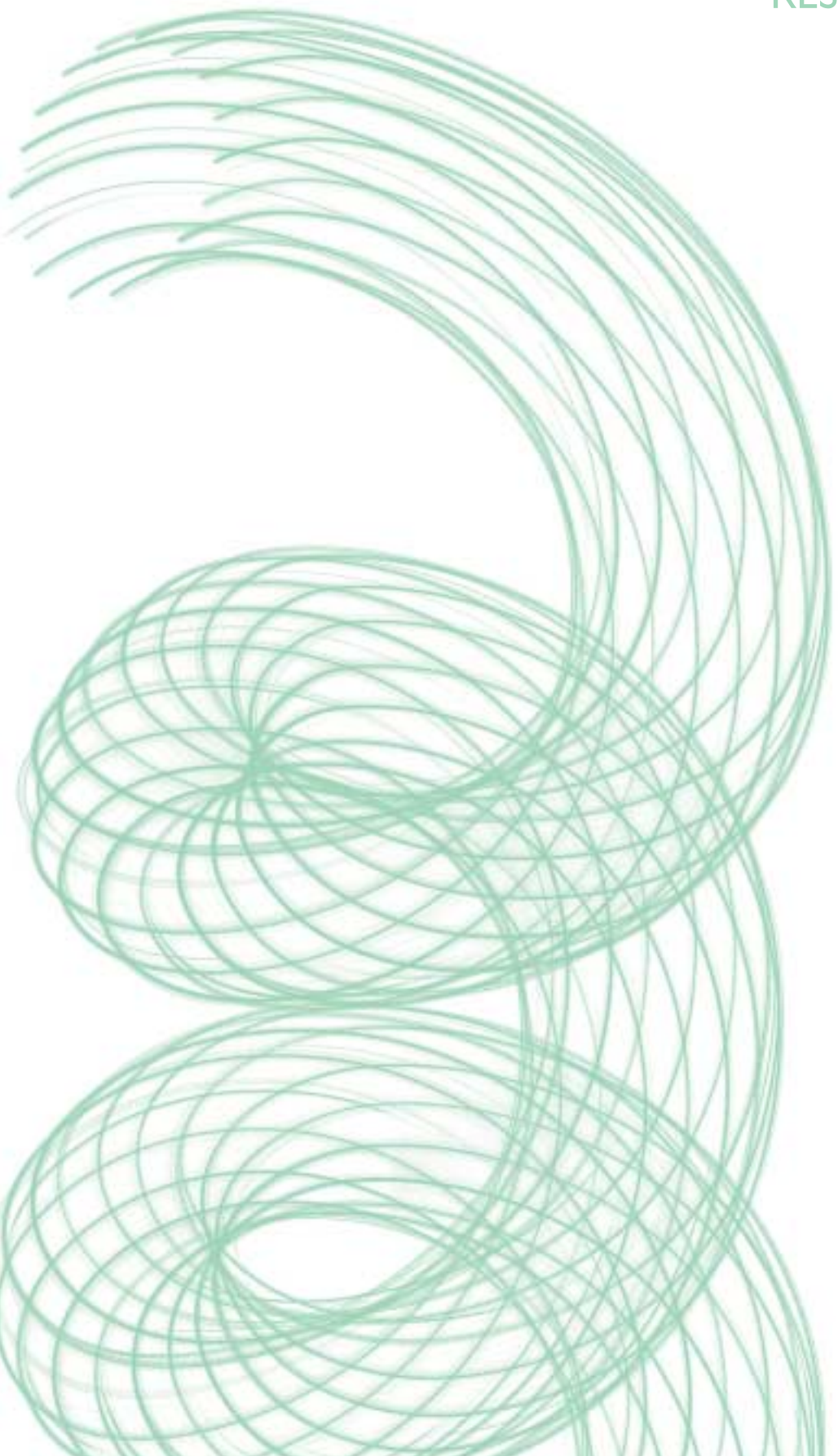

skills FOR BUSINESS

SECTORAL PRODUCTIVITY DIFFERENCES ACROSS THE UK

A report prepared for the:
Sector Skills Development Agency
By

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Sector Skills Development Agency: Research Series

Foreword

In October 2002 the Department for Education and Skills formally launched Skills for Business (SfB), a new UK-wide network of employer-led Sector Skills Councils (SSCs), supported and directed by the Sector Skills Development Agency (SSDA). The purpose of SfB is to bring employers more centre stage in articulating their skill needs and delivering skills-based productivity improvements that can enhance UK competitiveness and the effectiveness of public services. The remit of the SSDA includes establishing and progressing the network of SSCs, supporting the SSCs in the development of their own capacity and providing a range of core services. Additionally the SSDA has responsibility for representing sectors not covered by an SSC and co-ordinating action on generic issues.

Research, and developing a sound evidence base, are central to the SSDA and to Skills for Business as a whole. It is crucial in: analysing productivity and skill needs; identifying priorities for action; and improving the evolving policy and skills agenda. It is vital that the SSDA research team works closely with partners already involved in skills and related research to generally drive up the quality of sectoral labour market analysis in the UK and to develop a more shared understanding of UK-wide sector priorities.

The SSDA is undertaking a variety of activities to develop the analytical capacity of the Network and enhance its evidence base. This involves: developing a substantial programme of new research and evaluation, including international research; synthesizing existing research; developing a common skills and labour market intelligence framework; taking part in partnership research projects across the UK; and setting up an expert panel drawing on the knowledge of leading academics, consultants and researchers in the field of labour market studies. Members of this panel will feed into specific research projects and peer review the outputs; be invited to participate in seminars and consultation events on specific research and policy issues; and will be asked to contribute to an annual research conference.

The SSDA takes the dissemination of research findings seriously. As such it has developed this dedicated research series to publish all research sponsored by the SSDA and results are being made available in both hard copy and electronically on the SSDA website.

Lesley Giles

Head of Research at the SSDA

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EXECUTIVE SUMMARY

The research was commissioned to enhance our understanding of what is driving national productivity and in particular what might explain the gap between the UK and some of our international competitors. Previous work has suggested that the productivity gap has a strong sectoral and spatial dimension and it was important to enhance our understanding of this. This report analyses differences in labour productivity - defined as output per person in employment - between the countries and regions of the UK over the period 1992-2002. The study was intended to explore the variations in productivity across the UK and in particular to shed more light on the contribution that the sectoral distribution of employment makes to spatial productivity differences.

Method

The study uses a modified shift share analysis to analyse the productivity differentials within each country and region of the UK. The aim of the analysis is to decompose the differential and to deduce how much of the variation is due to the sector composition and specialisation in high performing sectors regionally and/or nationally.

The research employed output (Gross Value Added in 1995 prices) and employment (total number in employment) data developed for the Sector Skills Development Agency's (SSDA) *Working Futures* projections of occupational employment by sector and region[1]. These data were used to estimate labour productivity (namely output per person in employment)[2]. The data were derived from the Cambridge Econometrics (CE) multi-sectoral, regional macroeconomic model (RMDM). The CE model produces consistent regional and sectoral estimates of output and employment over time. One major advantage of using the CE output and employment projections is that this model-based approach mitigates the extent to which measurement problems (especially of output) can affect the differentials if alternative, grossed-up, survey-based estimates are used. They are also consistent over time.

The sectoral definitions utilised in this paper are those defined by the sector and industry groupings used in the *Working Futures* projections and in the SSDA Sector Matrix[3]. The analysis of spatial productivity was replicated for 1992, 1997 and 2002 in order to assess any changing patterns over time.

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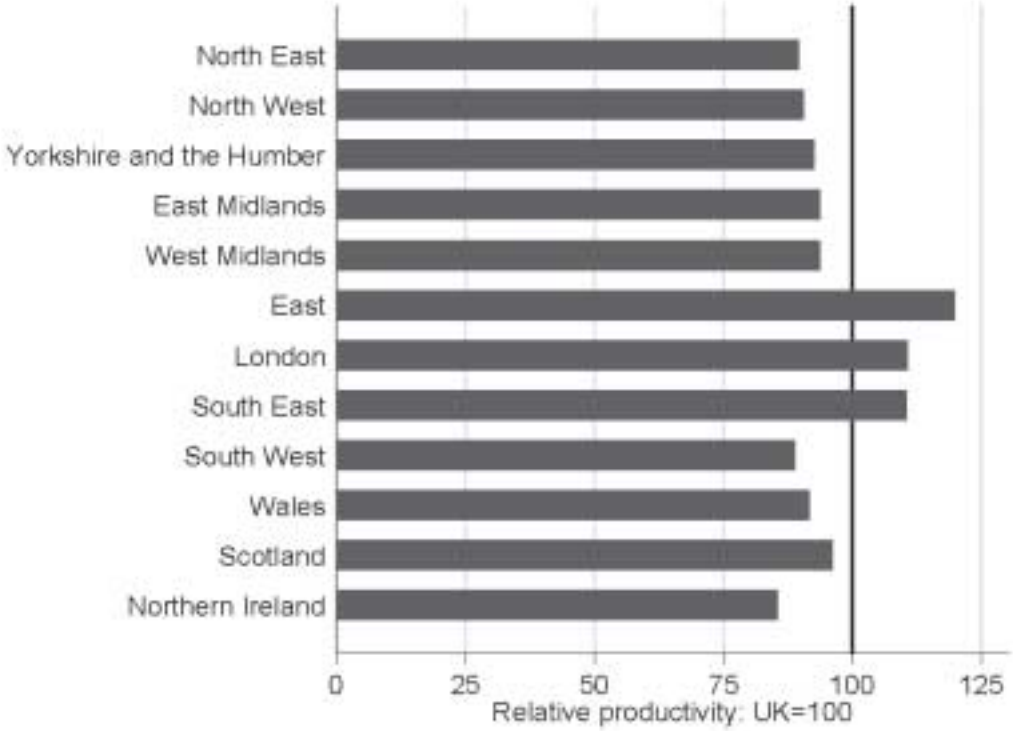
[1] Wilson *et al* (2003, 2004) and Green *et al* (2004).
[2] Wilson *et al* (2003, 2004) and Green *et al* (2004).
[3] Details of the sectoral groupings utilised are provided in Annex A. These are broad sectors and are not necessarily coterminous with the SSC footprints.

Results

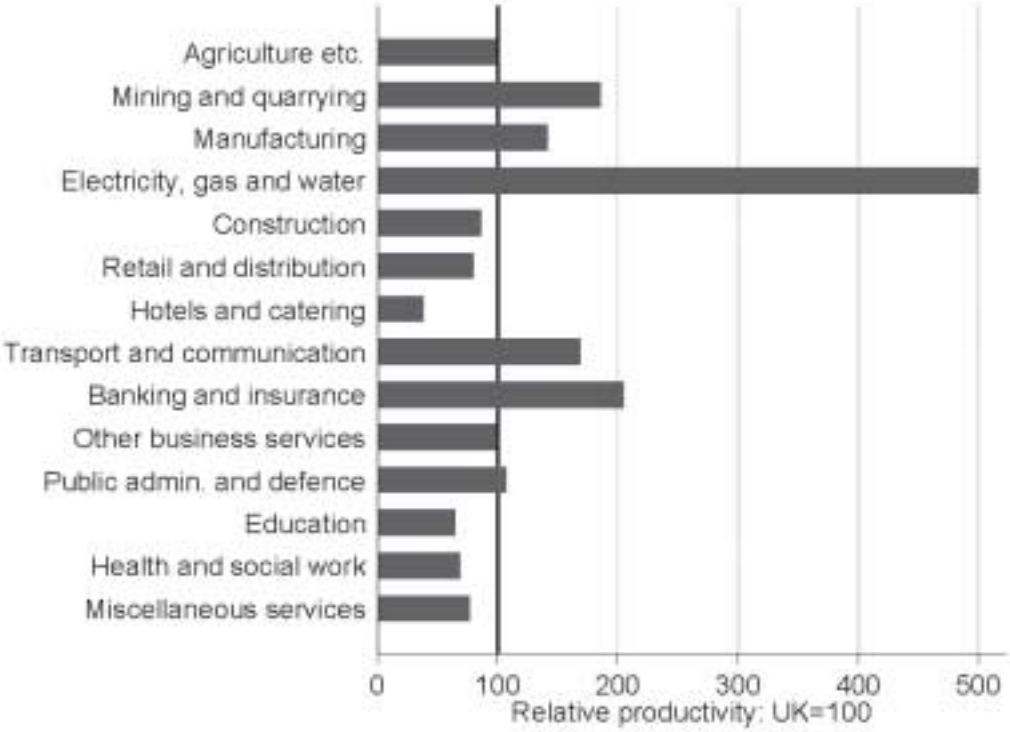
Over this period, the East, South East regions and London are seen to have consistently higher labour productivity than the rest of the UK. There is some evidence that spatial productivity differentials are widening over time. In 2002, labour productivity in the most productive region (East) was almost 35 percentage points higher than in the least productive area (Northern Ireland).

Distribution of relative productivity by country and region, 2002



Labour productivity differs much more between sectors than between countries and regions. This is to be expected and is partly a reflection of the nature of the goods and services produced by different sectors. For instance the Utilities sector stands out in having productivity five times the national average. In contrast, at the other end of the scale, Hotels and catering has productivity which is only 38% of the national average in 2002. Other retail distribution also has very low labour productivity. Clearly, both Hotels and catering, and Other retail distribution have large shares of part-time employment, and this may serve to accentuate their low labour productivity since it is measured here as output per person in employment. Over time, the gap between the most productive and least productive sectors also appears to be widening.

Distribution of relative productivity by sector, 2002



International comparisons suggest these issues warrant further attention as there is a productivity gap between the UK and its counterparts abroad, which is as large as 40% as measured by value added per worker between the UK and the US. Previous work has suggested that Retail and distribution, Banking and insurance and part of Manufacturing in the 14-sector classification used for this research contributed significantly to the international productivity gap. As shown in this project, Retail and distribution has low relative productivity in the UK, but Banking and insurance has productivity equal to twice the national average. Hence even in apparently high productivity sectors in the UK, there may still be scope for considerable improvements in productivity compared to our competitors.

The analysis then decomposes the productivity differentials. The results of this shift-share analysis reveal that sector mix and specialisation in high productivity sectors account for very little of the spatial productivity differentials observed. That is, the East, South East and London do not have higher productivity because they have disproportionate shares of employment in the sectors which have high productivity, or because they are specialised in sectors in which they perform better than the national average. Rather, they tend to have higher than average productivity across the majority of sectors. It is not the sectoral

specialisation that has most effect but rather the differential performance of the same sector in different countries and regions. Hence, spatial and sectoral factors in combination are important. Indeed, it appears that sectors in high performing areas are able to optimise the regional factors to achieve better productivity. The higher performing countries and regions can thus provide an upper benchmark that sectors in other poorer performing areas can aspire to.

One important caveat is that the findings may partly reflect the measurement of sectoral output at the regional level. The data utilised are necessarily model-based forecasts since consistent sectoral and regional output and employment data are not available from official government statistics over the time period and at the levels of disaggregation required. Thus, the output and employment - and hence productivity - patterns across regions and sectors may be partly a consequence of the modelling process itself, rather than reflecting actual differences. There are also important regional price and cost-of-living factors which cannot be fully taken into account given the available data.

Subject to this possible limitation regarding the data, the central conclusion is that the inter-regional variance in output per person in employment can be attributed to productivity differences that are fairly consistent across sectors. This finding suggests that an investigation of the factors that contribute to inter-regional productivity should focus on differences at the regional level - for instance infrastructure and other spatial factors, such as physical and human capital - including skills and the occupational distribution of employment within sectors. It also supports the use of regional and sectoral policy aimed at uniform productivity increases in poorly performing countries and regions. It is thus important that future initiatives such as Sector Skills Agreements retain a country and regional focus to their sector Skills Needs Assessments and their forthcoming sectoral strategies to improve skills and productivity.

SECTORAL PRODUCTIVITY DIFFERENCES ACROSS THE UK

1. Introduction

A central objective of Government administrations across the UK is achieving high and stable levels of economic growth and employment. Improving the productivity of the UK economy is an essential element behind achieving growth and increasing levels of prosperity. It is evident that improving performance has important sectoral and geographical or regional dimensions. Thus, a number of initiatives have been developed across different parts of the UK to strengthen the sectoral and regional policy frameworks and to enhance business efficiency and competitiveness. The establishment of the Sector Skills Development Agency (SSDA) and its network of Sector Skills Councils (SSCs), and also geographically focused bodies across the UK, such as the Regional Development Agencies (RDAs) in England, Welsh Development Agencies in Wales and the Local Enterprise Councils in Scotland, are essential elements of this overall UK strategy. These agencies have been specifically remitted to intervene to promote improved economic development, growth and productivity, both sectorally and regionally.

Britain's poor international performance in the productivity league tables has long been a cause of concern[4]. However, there is evidence that more recent performance is rather better than in the past. Moreover, international comparisons of productivity are hampered by difficulties in measuring prices, output, capital input, and hours worked[5]. Better quality data - including on hours worked, and on differences in international prices (i.e. purchasing power parities) in particular - have served to narrow some of the previously large differences between Britain and her major competitors. In the latest revision for 2002, for example, the UK is now seen to have approximately the same level of productivity as measured by per capita output as Germany, although remains around 13% weaker than the average of all G7 countries excluding the UK. While this represents a considerable improvement over the last

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[4] For recent evidence, see Porter and Ketels (2003) and O'Mahony and deBoer (2002).

[5] There have been several recent developments in the measurement of international productivity differences – see, for example, Schreyer and Pilat (2001), Richardson (2001) and Drew *et al* (2001).

decade - 10 years ago the gap was nearer 25% - further improvements in UK productivity are still required.

It is well-known that there are significant and persistent differences in economic performance between different parts of the UK (see, for example, Rice and Venables, 2003, 2004). Indeed, differences within the UK are greater than between the UK and other countries. For example, in 1999, the poorest parts of the UK (Northern Ireland, Wales and the North East) had a GDP per capita around 40% lower than that of the richest (London) (HMT/DTI, 2001). This degree of variation between different parts of the UK is large by international standards, especially compared to other EU countries, and the US. Clearly, such differences provide a constraint on the UK's aggregate economic performance.

These differences in regional prosperity can arise from variations in productivity (output per person) and/or the number of people in employment. As shown in HMT/DTI (2001), while the relative importance of each factor varies across regions, differences in productivity are the largest contributor to the regional GDP per capita variation - the difference between highest and lowest is in excess of 30 percentage points - and can account for about 60% of the total differentials. The remainder is due to differences in labour market participation and the age structure of the working-age population. However, it is apparent that regional participation rates and working-age population shares are both positively correlated with regional productivity levels - so that more productive regions would appear to attract more labour market participants (and vice versa). This suggests that understanding regional productivity differences is more important than even the magnitude of the differentials would suggest.

While a number of endeavours are currently underway to understand Britain's productivity performance[6], further work is necessary to investigate and to understand more fully the inter-regional variations in productivity and their relationship to the sectoral composition of employment. Such analysis needs to explore further the extent to which inter-regional variations in productivity are a function of sectoral

[6] HMT (2000, 2001), HMT/DTI (2001, 2004), HMT/ODPM (2003), Haskel and Martin (2002), Haskel *et al* (2003) for example.

composition, as well as other factors such as differences in regional infrastructure, physical and human capital.

This report contributes towards this research agenda by analysing the extent to which *labour* productivity differentials across the countries and regions of the UK can be attributed to differences in sectoral employment composition, or if spatial factors tend to affect sectoral performance more uniformly across regions. That is, it attempts to distinguish between regional productivity differentials that arise because some regions have a greater concentration of employment in more highly performing sectors, and those that accrue because many or all sectors perform better in some regions as compared to others. The analysis of regional productivity differentials is replicated for 1992, 1997 and 2002 in order to assess any changing patterns over time.

An important constraint on the investigation of regional productivity differentials is the paucity of detailed data on country and regional output at the sectoral level[7]. The data utilised in this paper are the output and employment projections derived from the Cambridge Econometrics (CE) multi-sectoral, regional macroeconomic model (RMDM) and up-dated for the *Working Futures* projections of occupational employment by sector and region[8]. The CE model produces consistent regional and sectoral estimates of output and employment over time. Thus, while they are consistent with published sources, both output and employment, and thus the measure of labour productivity used in this paper, are model-based 'forecasts', rather than being measures of actual outturns. One major advantage of using the CE output and employment projections is that this model-based approach mitigates the extent to which measurement problems (especially of output) can affect the differentials if alternative, grossed-up, survey-based estimates are used. They are also consistent over time. However, there are potential uncertainties in the data generated by the modelling process itself.

[7] See Allsopp (2003, 2004).
[8] Wilson *et al* (2003, 2004) and Green *et al* (2004).

Using these data, it is possible to construct measures of labour productivity by country and region, and sector within country and region, for a variety of different sectoral classifications. The sectoral definitions utilised in this paper are those defined by the sector and industry groupings used in the *Working Futures* projections and in the SSDA Sector Matrix[9]. The spatial classification used is restricted to the NUTS 1 level[10]. Labour productivity is measured as real (1995 prices) output per person in employment.

The remainder of the report is structured as follows. Section 2 presents the measure of labour productivity derived from the *Working Futures* output and employment projections, and the variation between countries and regions, and sectors, and over time, is described. Section 3 presents a shift-share decomposition analysis in which the overall country and regional productivity differentials are decomposed into the separate contributions arising from regional specialisation in high/low productivity sectors and from productivity differences which tend to affect all sectors within regions. A number of caveats and potential areas for further research are noted. Finally, section 4 concludes.

2. Spatial and sectoral labour productivity in the UK

2.1 Data on output and employment

The data utilised in the remainder of the paper are derived from the *Working Futures* projections of output and employment which are, in turn, obtained from the CE RMDM[11]. This model has a Keynesian structure incorporating an input-output system. A distinctive feature for the country and region data is that they are based on a fully-specified and coherent model of the UK regional economies. Thus, each country and region is modelled separately, with the results for the UK obtained by summation. Compared with other large-scale macroeconomic models, the industry

[9] Details of the sectoral groupings utilised are provided in Annex A. These are broad sectors and are not necessarily coterminous with the SSC footprints.
[10] The NUTS 1 level (Nomenclature of Units for Territorial Statistics) regions for the UK comprise the nine English regions plus Scotland, Wales and Northern Ireland.
[11] See Barker and Peterson (1987) and Cambridge Econometrics (2003).

detail in the CE model is considerable, with 49 separate employing activities distinguished. The current version of the model used to produce the *Working Futures* projections utilised in this paper is based on the 2002 National Accounts and the latest regional accounts data. It also incorporates the headline 2001 Census figures that were available at the time that the forecast was constructed (June 2003). Estimates of output and employment by country and region, and sector, for 1992, 1997 and 2002 are used to derive the measures of labour productivity used below.

The measure of output derived in the model is Gross Value Added (GVA) in 1995 prices. Under the ESA95 (European System of Accounts, 1995 revision), the term GVA is used for estimates that were previously known as Gross Domestic Product (GDP) at basic prices. Regional accounts are currently only published by ONS at basic prices, so the figures are now referred to as GVA rather than GDP as previously[12]. Given that the CE model is consistent with the National Accounts, the output measure is thus GVA. In the absence of regional price deflators, the data are deflated using a common price base. Given that we use output levels rather than growth rates, the relativities between regions should be fairly robust over time, as should the magnitude of the differentials. However, there are clearly important regional price and cost-of-living factors which are not taken into account.

Employment is measured as the total number in employment. There is no estimate of hours worked in the *Working Futures* projections and clearly this is a weakness when measuring productivity given that, across the whole economy, around 30% of jobs are part-time, but these are distributed very unequally between sectors. The implications of this for the findings, together with some suggestions for further work to take account of differences in hours worked are presented in Section 3.4.

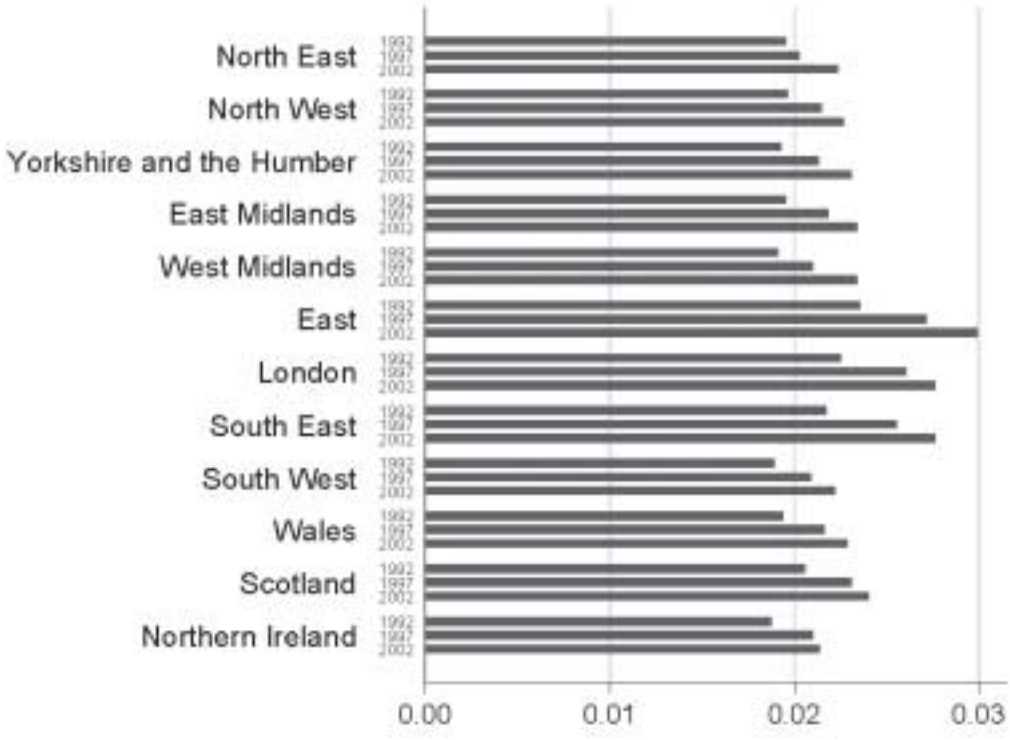
2.2 Aggregate labour productivity by country and region

Figure 1a depicts aggregate regional productivity for 1992, 1997 and 2002 for the 12 NUTS 1 countries and regions of the UK. All countries and regions have experienced

[12] Under ESA95, the term GDP denotes GVA plus taxes less subsidies, i.e. GDP at market prices.

increasing levels of real output per person in employment over the decade 1992-2002, consistent with the increase in aggregate productivity, but clearly some countries and regions have increased their productivity more rapidly than others. However, there is considerable stability in the rank order of countries and regions in terms of their productivity as shown in Table 1. Productivity is measured as GVA £millions per person in employment, deflated to constant (1995) prices. Thus, average productivity was around £20,600 per person in 1992, increasing to £25,000 by 2002, a real increase of about 21%. The four areas with the highest productivity - East, London, South East and Scotland - are the same in all three years under investigation, and they appear in the same position in the ranking in each year[13]. At the bottom of the distribution, there is more movement in the ranking, although Northern Ireland and the South West are consistently ranked amongst the bottom three .

Figure 1a: Distribution of aggregate productivity by country and region, 1992-1997-2002



[13] The Spearman rank order correlation coefficients are ρ=0.86 for 1992 *vs* 1997, ρ=0.88 for 1997 *vs* 2002 and ρ=0.81 for 1992 *vs* 2002. The aggregate productivity levels are also strongly correlated over time – with correlation coefficients in excess of 0.97.

Table 1: Productivity by country and region, 1992-1997-2002: levels and ranking

	Aggregate productivity			Ranking		
	1992	1997	2002	1992	1997	2002
North East	0.0195	0.0202	0.0224	7	12	10
North West	0.0196	0.0215	0.0226	5	7	9
Yorkshire and the Humber	0.0193	0.0213	0.0231	9	8	7
East Midlands	0.0195	0.0218	0.0234	6	5	6
West Midlands	0.0191	0.0210	0.0234	10	9	5
East	0.0236	0.0271	0.0299	1	1	1
London	0.0225	0.0261	0.0276	2	2	2
South East	0.0217	0.0256	0.0276	3	3	3
South West	0.0189	0.0209	0.0222	11	11	11
Wales	0.0194	0.0216	0.0229	8	6	8
Scotland	0.0206	0.0231	0.0240	4	4	4
Northern Ireland	0.0188	0.0210	0.0214	12	10	12
Average	**0.0206**	**0.0232**	**0.0250**			

Note: Productivity is measured as GVA £millions (measured in constant (1995) prices) per person in employment.

This consistency in the rank order of country and regional productivity over time can be seen more clearly in Figure 1b which displays productivity in each region and country relative to the UK average (scaled to 100) in each year. The general increase in dispersion between the regions is also evident in Figure 1b. That is, there is evidence of divergence over time in regional productivity with the best performing regions (especially the East) getting further ahead of the national average and the more poorly performing regions lagging further behind. Moreover, only three regions have aggregate productivity above the national average, while nine have aggregate productivity below the national average. This reflects the relative size of the most productive regions - both London and the South East each have more than 4 million in employment in 2002 as shown in Figure 2a and Table 2, and, together with the East, the three regions with above average productivity now account for over 38% of all those in employment as shown in Table 2. That more regions have below average productivity than above average productivity is also a reflection of the fact that the distribution of productivity by country and region is positively skewed.

Figure 1b: Distribution of relative productivity by country and region, 1992-1997-2002

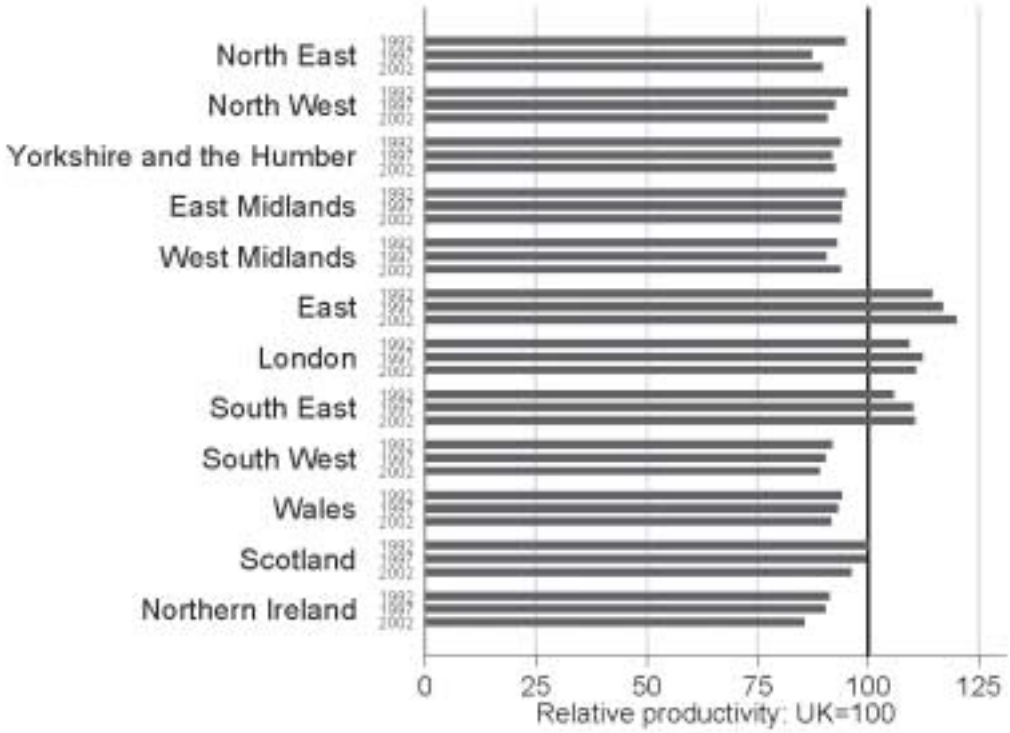


Figure 2a: Distribution of employment by country and region, 1992-1997-2002: levels

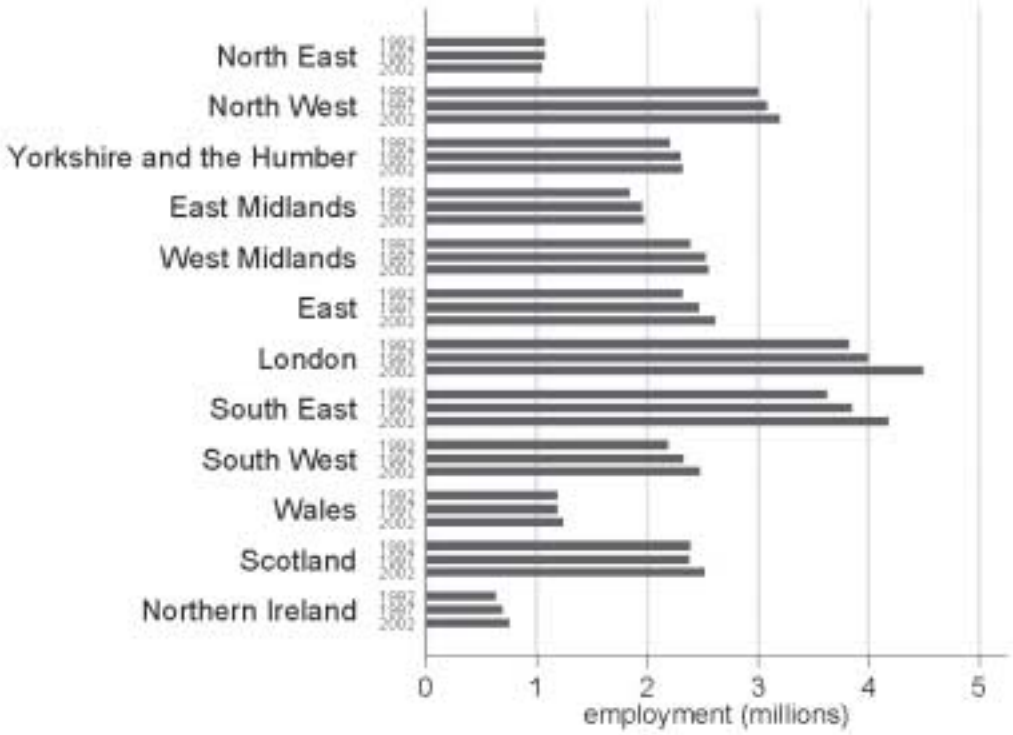


Figure 2b: Distribution of employment by country and region, 1992-1997-2002: shares

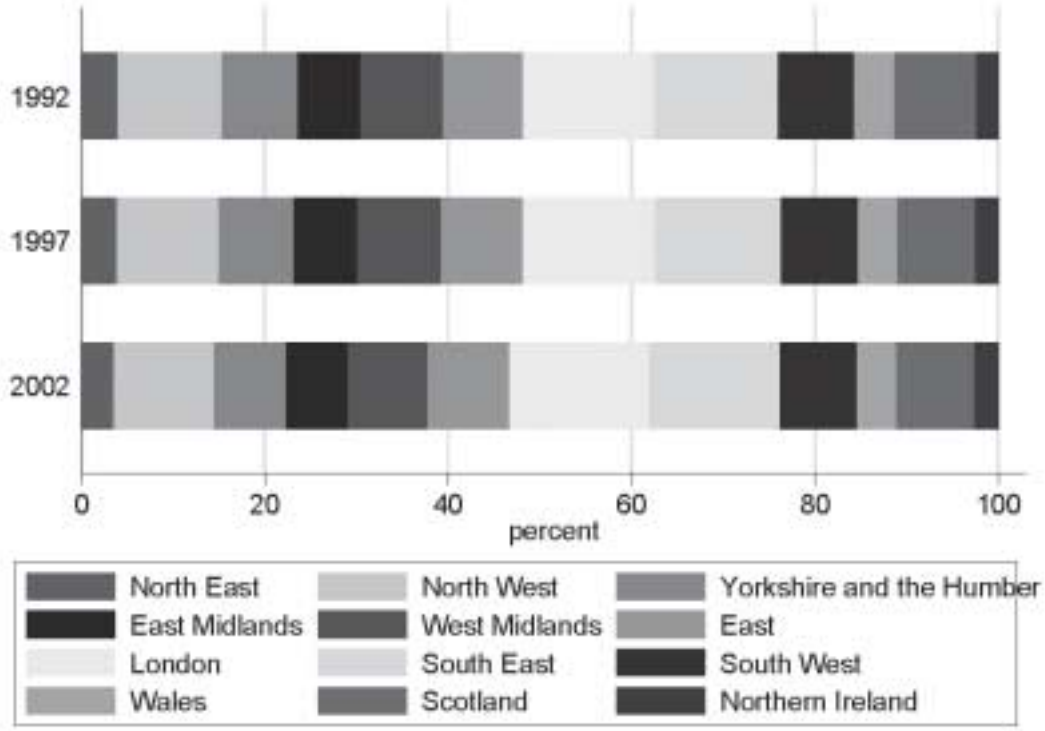


Table 2: Employment by country and region, 1992-1997-2002: levels and shares

	Employment (000s)			Employment share (%)		
	1992	1997	2002	1992	1997	2002
North East	1,070	1,070	1,045	4.0%	3.9%	3.6%
North West	3,000	3,076	3,194	11.3%	11.1%	10.9%
Yorkshire and the Humber	2,207	2,295	2,313	8.3%	8.3%	7.9%
East Midlands	1,838	1,951	1,972	6.9%	7.0%	6.7%
West Midlands	2,388	2,522	2,554	9.0%	9.1%	8.7%
East	2,319	2,464	2,614	8.7%	8.9%	8.9%
London	3,824	3,990	4,490	14.4%	14.4%	15.3%
South East	3,618	3,843	4,179	13.6%	13.8%	14.3%
South West	2,181	2,324	2,470	8.2%	8.4%	8.4%
Wales	1,184	1,186	1,241	4.4%	4.3%	4.2%
Scotland	2,383	2,375	2,511	9.0%	8.6%	8.6%
Northern Ireland	629	687	752	2.4%	2.5%	2.6%
Total	**26,639**	**27,783**	**29,336**	**100.0%**	**100.0%**	**100.0%**

The magnitude of the country and regional productivity differentials in absolute and relative terms is shown in Figure 3a and Figure 3b respectively. The increasing divergence between different parts of the UK can be most clearly seen here, with the gap between the best (East) and worst (Northern Ireland) performing in productivity terms in 2002 being almost £9,000 (1995 prices), or, in percentage terms, almost 35 percentage points.

Figure 3a: Aggregate productivity differentials by country and region, 1992-1997-2002

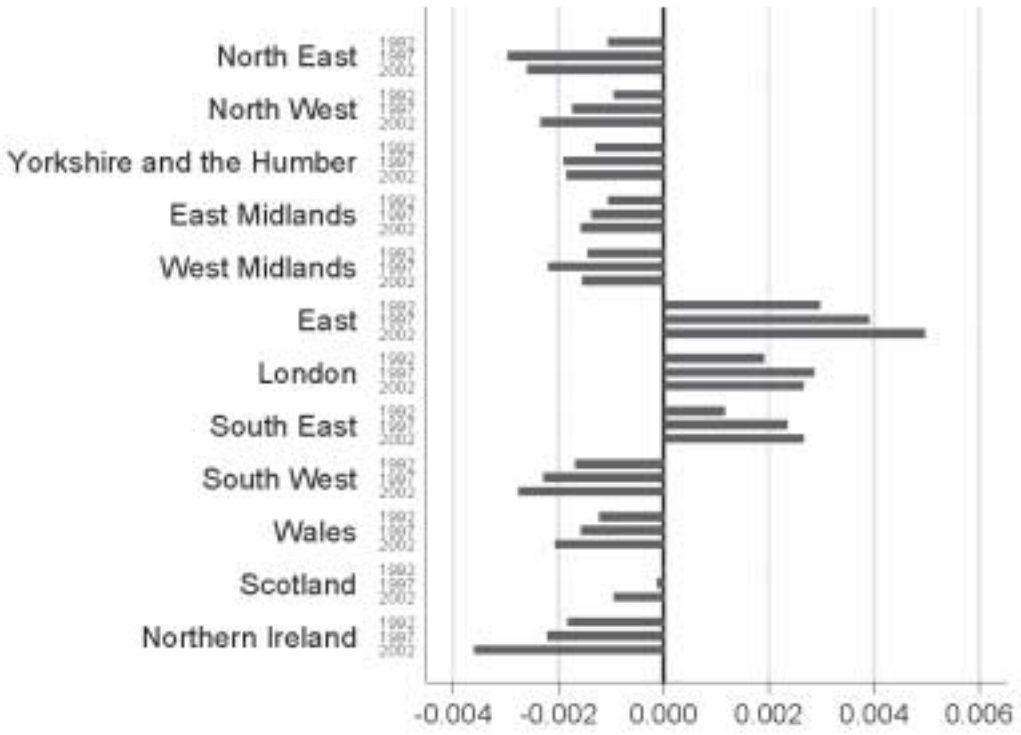
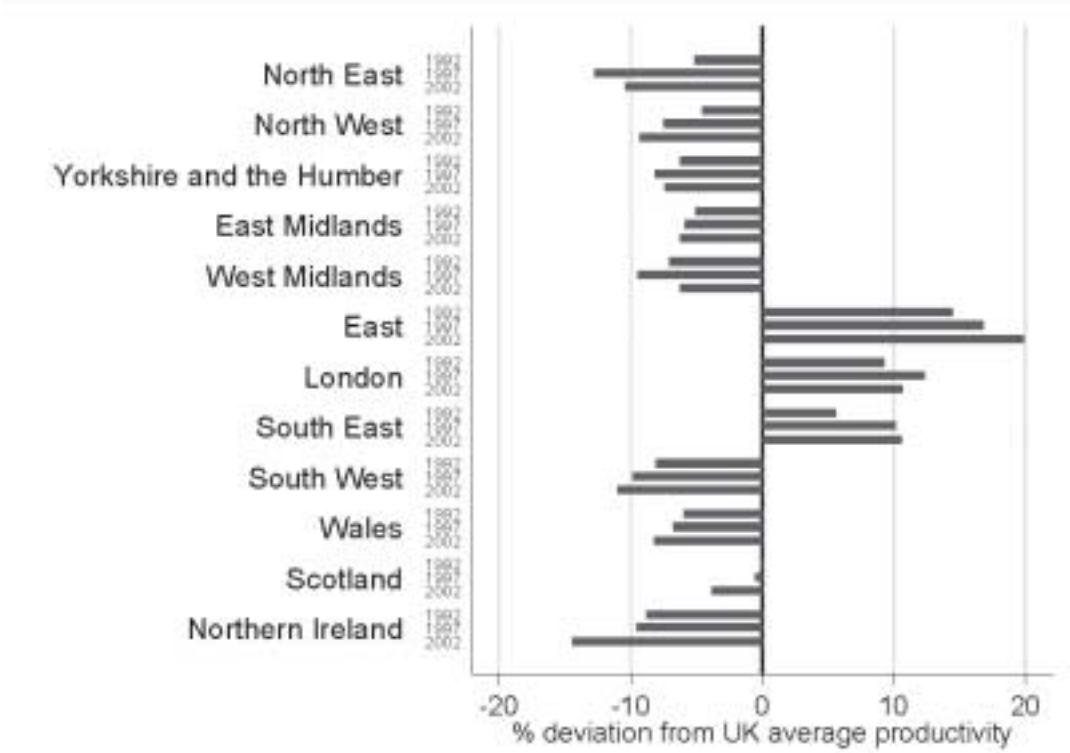


Figure 3b: Relative productivity differentials by country and region, 1992-1997-2002



2.3 Aggregate labour productivity by sector

Figure 4a and 4b present the distribution of aggregate and relative productivity by broad sector for 1992, 1997 and 2002. Clearly some sectors have increased their absolute and relative performance over the last decade. In 2002, the most productive sector - Primary and utilities - had a value of output per person in employment 2.5 times the least productive sector - Non-marketed services – as shown in Table 3. In comparison, the ratio between the most and least productive sectors was 2.1 in 1992. Thus, there is evidence of increasing dispersion in sectoral productivity over time.

Figure 4a: Distribution of aggregate productivity by 6 sectors, 1992-1997-2002

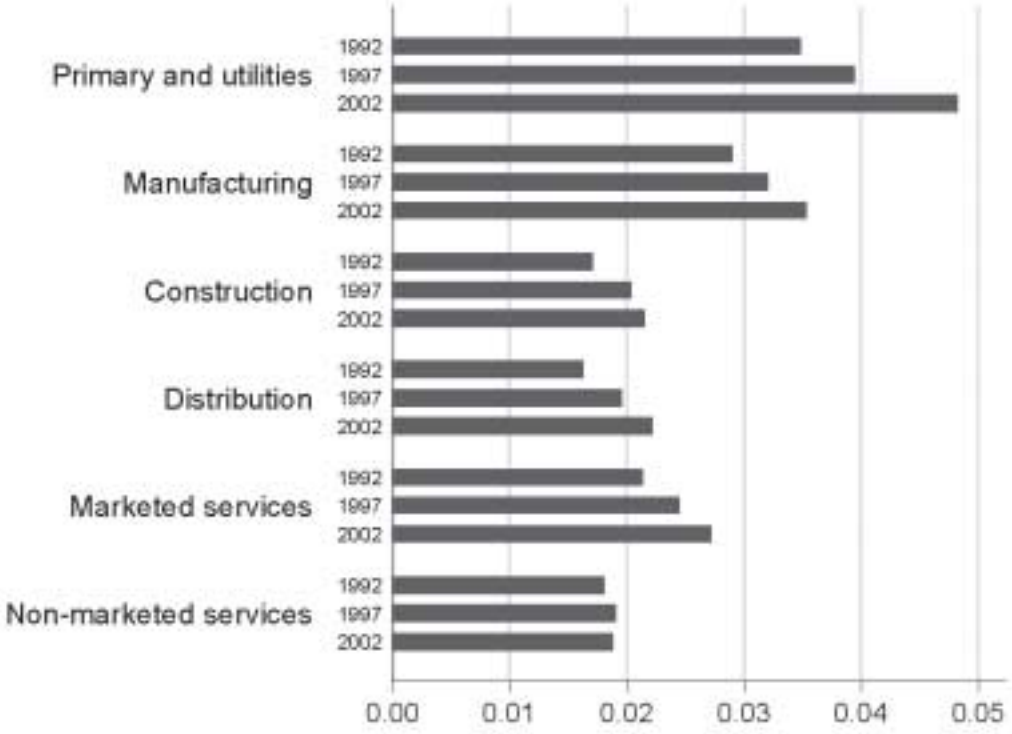


Figure 4b: Distribution of relative productivity by 6 sectors, 1992-1997-2002

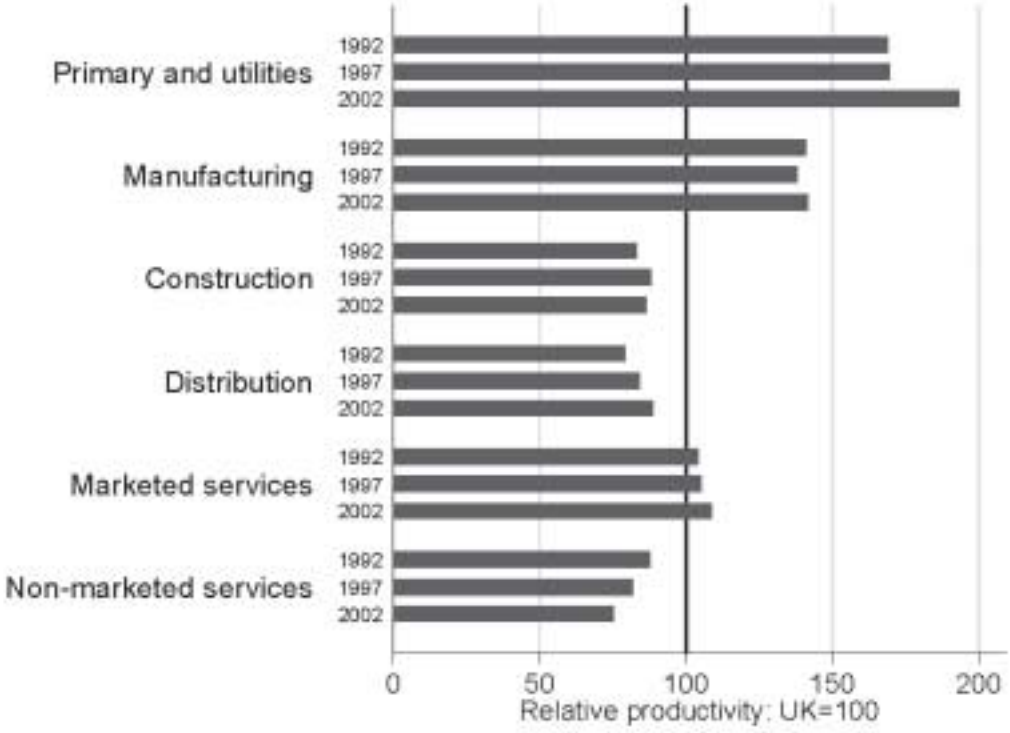


Table 3: Productivity by sector, 1992-1997-2002: levels and ranking

	Aggregate productivity			Ranking		
	1992	1997	2002	1992	1997	2002
Primary and utilities	0.0348	0.0394	0.0482	1	1	1
Manufacturing	0.0290	0.0321	0.0353	2	2	2
Construction	0.0171	0.0204	0.0216	5	4	5
Distribution	0.0163	0.0195	0.0222	6	5	4
Marketed services	0.0214	0.0244	0.0272	3	3	3
Non-marketed services	0.0181	0.0191	0.0188	4	6	6
Average	**0.0206**	**0.0232**	**0.0250**			

The impact that these differing sectoral productivities can have on aggregate productivity by region and over time depends, at least in part, on how large the sectors are - or rather, their shares in regional employment. Figure 5a presents the numbers employed by broad sector for each of the three years, while Figure 5b illustrates the changes in employment shares. The continued transition in employment from manufacturing to services - especially Marketed services - is clearly evident. As shown in Table 4, the Manufacturing share of employment fell from 16.6% in 1992 to 13.2% in 2002, while Marketed services increased its share from 21.1% to 25.6% in the same period. Overall, employment rose by almost 2.7 million between 1992 and 2002.

Figure 5a: Distribution of employment by 6 sectors, 1992-1997-2002: levels

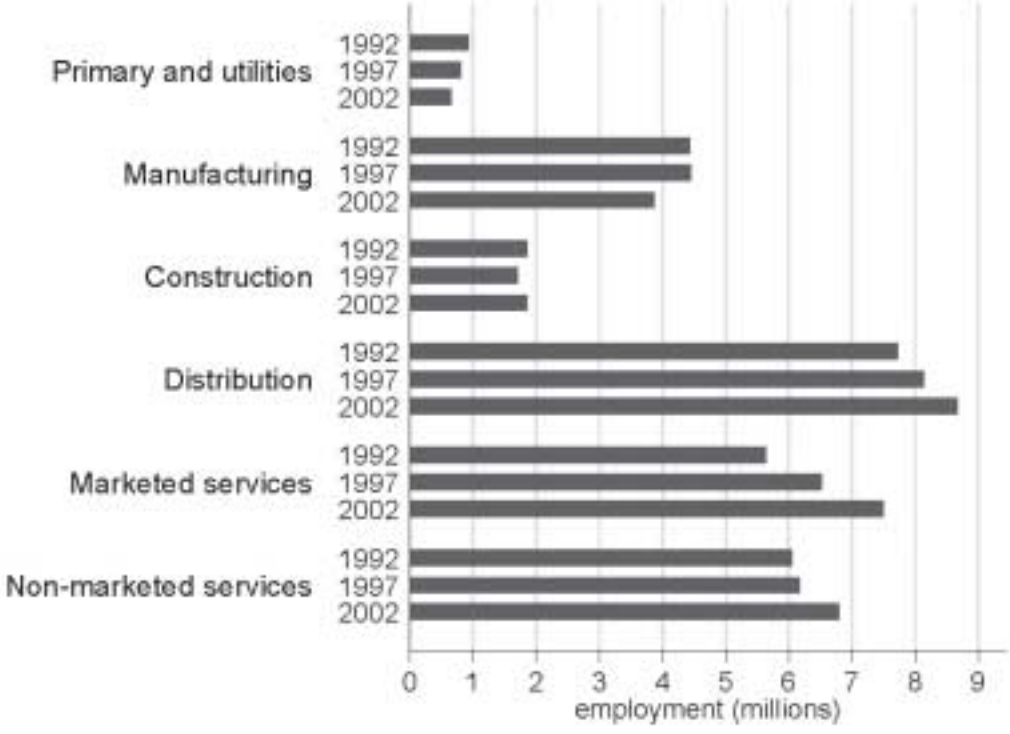


Figure 5b: Distribution of employment by 6 sectors, 1992-1997-2002: shares

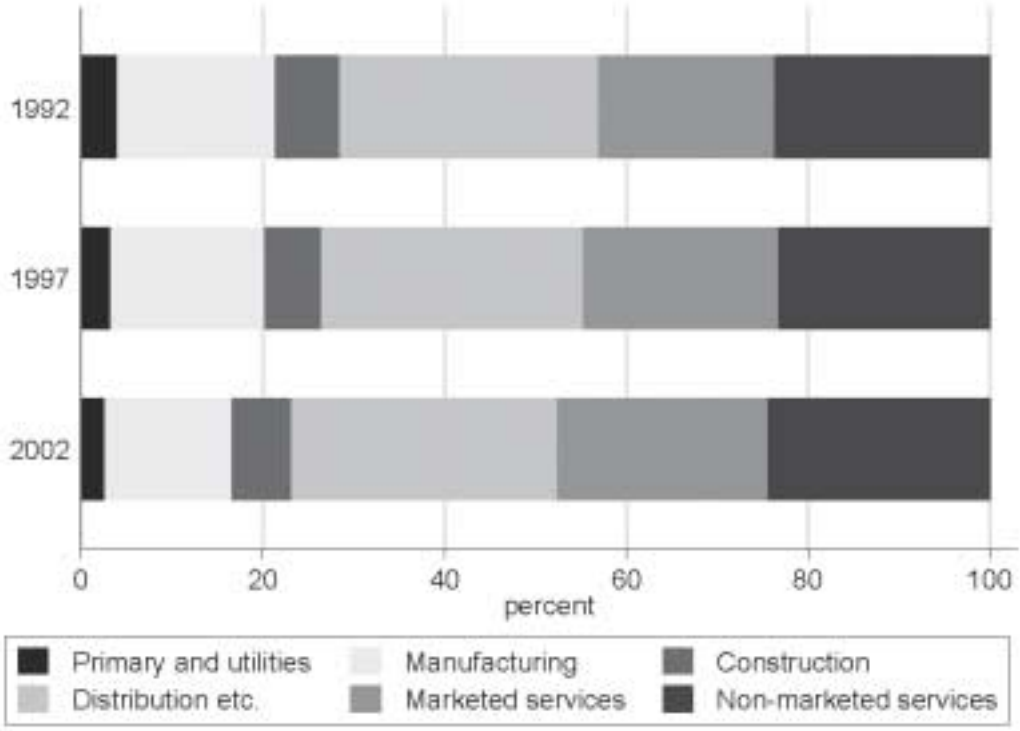


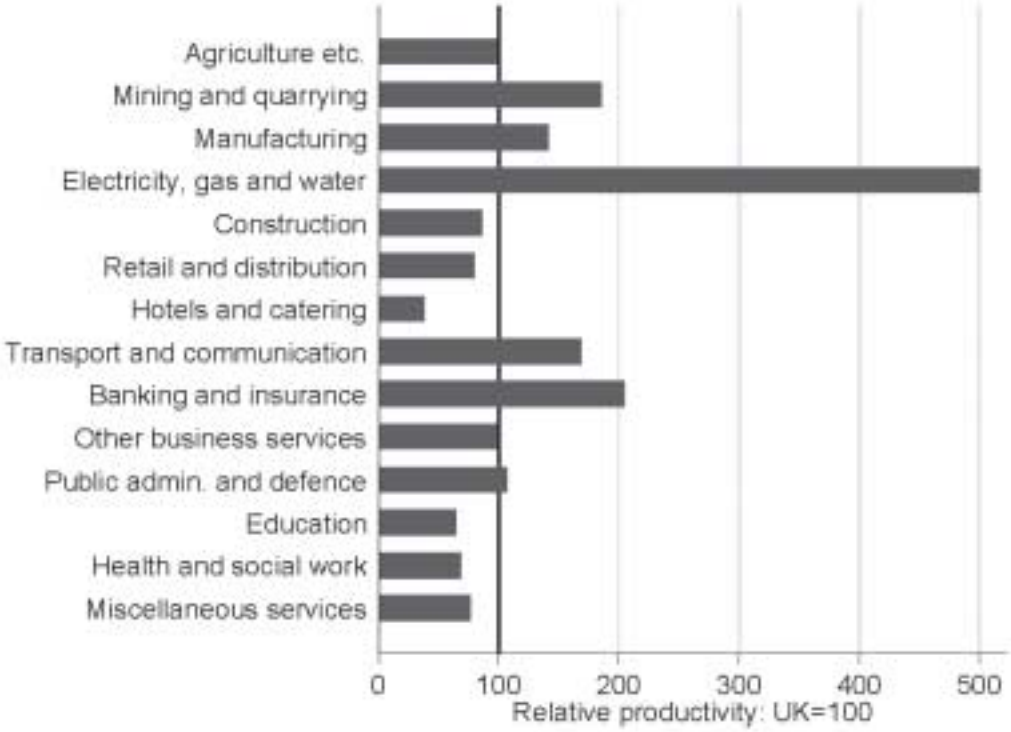
Table 4: Employment by sector, 1992-1997-2002: levels and shares

	Employment (000s)			Employment share (%)		
	1992	**1997**	**2002**	**1992**	**1997**	**2002**
Primary and utilities	928	803	660	3.5%	2.9%	2.3%
Manufacturing	4,431	4,442	3,868	16.6%	16.0%	13.2%
Construction	1,866	1,705	1,854	7.0%	6.1%	6.3%
Distribution	7,725	8,135	8,669	29.0%	29.3%	29.6%
Marketed services	5,631	6,522	7,498	21.1%	23.5%	25.6%
Non-marketed services	6,060	6,175	6,787	22.8%	22.2%	23.1%
Total	**26,639**	**27,783**	**29,336**	**100.0%**	**100.0%**	**100.0%**

Of course, the Primary and utilities sector is dominated by the extraction of crude petroleum and natural gas which is very capital intensive, as are electricity, gas and water. This will partly account for the Primary and utilities sector having much higher labour productivity than the other sectors. Some of the other broad sectoral groupings will also disguise considerable variation in performance between their sub-sectors. Figure 6a and 6b illustrate relative productivity by sector in 2002 using the more detailed 14 sector and 25 sector classifications as utilised in the regional and

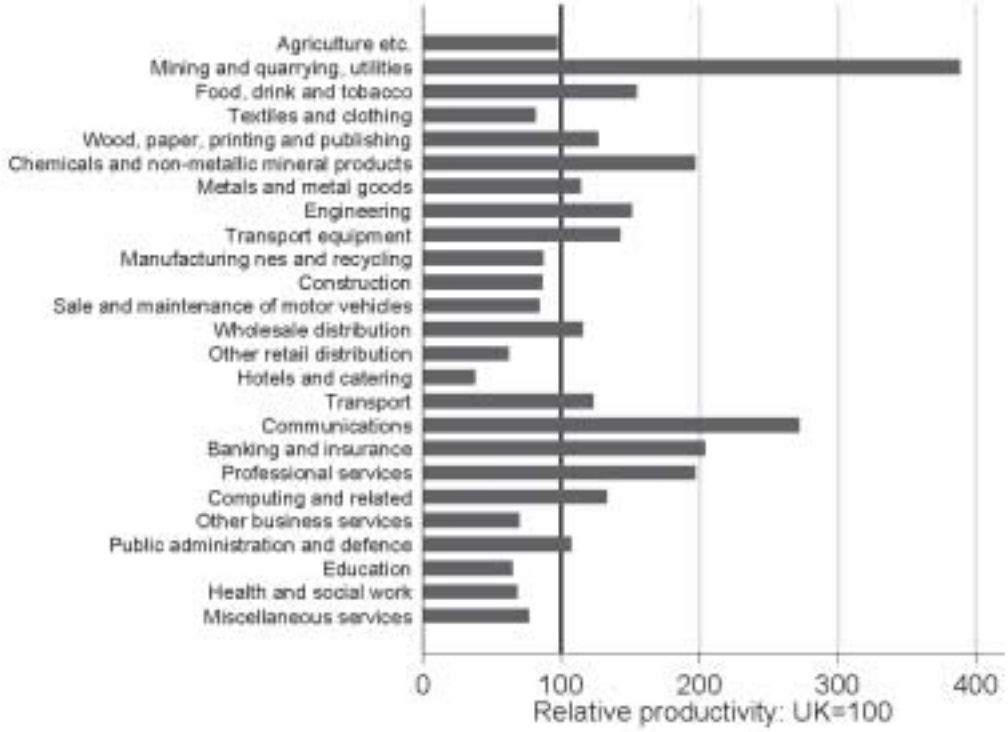
national *Working Futures* reports[14]. The Utilities sector stands out in having productivity five times the national average. In contrast, at the other end of the scale, Hotels and catering has productivity which is only 38% of the national average in 2002. Other retail distribution also has very low labour productivity. Clearly, both of these sectors have large shares of part-time employment, and this may serve to accentuate their low labour productivity since it is measured here as output per person in employment.

Figure 6a: Distribution of relative productivity by 14 sectors, 2002



[14] See Green *et al* (2004) and Wilson *et al* (2004) respectively.

Figure 6b: Distribution of relative productivity by 25 sectors, 2002



These patterns in sectoral productivity can also help to explain the productivity gap between the UK and the US which is approximately 40% as measured by value added per worker. Griffith *et al* (2003) demonstrate that over half of this gap can be attributed to just three of the 11 sectors in the classification they utilise – 'wholesale and retail', 'financial intermediation' and 'machinery and equipment'. These three sectors correspond to Retail and distribution, Banking and insurance and part of Manufacturing respectively in our 14-sector classification[15]. Figure 6a illustrates that Retail and distribution has low relative productivity in the UK, but Banking and insurance has productivity equal to twice the national average. Hence even in apparently high productivity sectors in the UK, there may still be scope for considerable improvements in productivity.

[15] In the 25 sector classification, 'wholesale and retail' comprises *Sale and maintenance of motor vehicles*, *Wholesale distribution* and *Other retail distribution*; 'financial intermediation' is identical to *Banking and Insurance*, and 'machinery and equipment' is equivalent to *Engineering*.

There are clearly greater differences in productivity between sectors than between countries and regions. We now turn to examine the extent to which the differences between countries and regions are due to differences in the sectoral composition of employment - such that some areas have a greater share of employment in the more productive sectors - or are a result of a general impact on the productivity of all sectors within an area.

3. Decomposing spatial labour productivity differences

A particular country or region may have aggregate productivity above the national average for two distinct reasons. First, its sectoral productivities may not differ much from the mean, but the region may be specialised in sectors with high productivity. Thus, for example, average productivity in manufacturing and services could be equal across all parts of the UK, but those regions which are specialised in manufacturing would have higher productivity per worker than those specialised in services because, on average, manufacturing has higher productivity than services. Second, most or all sectors in the region may have productivities above the UK national sectoral averages, perhaps reflecting region-specific factors such as infrastructure differences or differences in the physical capital or skills composition locally. Of course, there may be a combination of these two factors in operation. In order to establish the importance of each factor - sectoral specialisation in high productivity sectors or overall high regional performance - to the aggregate regional differential, we can use a modified shift-share analysis to decompose each region's productivity difference from the UK national average into that due to the industry mix of the region and that due to the region-specific productivity differential.

3.1 Decomposition using shift-share analysis

As shown in Annex B, the methodology of shift-share analysis as originally proposed by Dunn (1960) can be extended to the decomposition of inter-regional aggregate productivity differentials. Esteban (2000) demonstrates that a region's productivity differential from the national average can be decomposed into three components:

- an industry mix component;
- a productivity differential component; and
- an allocative component.

These three components then can be added together to yield the overall regional productivity differential.

Industry mix

The industry mix component measures the contribution to the regional productivity differential that accrues from a region's specific sectoral composition, assuming that the sectoral productivities in each region are equal to the national average. The industry mix component is therefore that part of the regional productivity differential that is the consequence of regions being specialised in the most or least productive sectors. Thus the industry mix component is positive if the region is specialised in sectors with high productivity and/or de-specialised in sectors with low productivity.

Productivity differential

The productivity differential component is the contribution to the regional productivity differential that arises from sectoral differences in productivity between the region and the national average, assuming the region's sectoral composition matches the national picture. Hence the productivity differential component is positive if the region has above average sectoral productivities in most or all sectors – that is, if most or all sectors perform above their national averages in the region.

Allocative component

The allocative component is the contribution to the regional productivity differential that derives from a region being specialised, relative to the national average, in sectors in which it has above or below average productivity. The allocative component can be interpreted as an indicator of the efficiency in each region in allocating employment to the sectors in which it has comparative advantage. It also measures the covariance between the industry mix and productivity differential.

As demonstrated in Annex B, the overall gap between a region's aggregate productivity and the national average can be additively decomposed into these three components, such that:

regional differential	=	industry mix component	+	productivity differential	+	allocative component

To gauge the relative contribution of each component to overall regional productivity differential, Esteban (2000) suggests two approaches, both of which are utilised in this paper. First, he computes the relative weight of the variances of each component in the overall variance in differentials. Thus the overall variance in the regional differentials can be written as the sum of the variances of each component, plus an additional term capturing the covariances between the components. In addition, we supplement this decomposition by presenting the overall regional differential and its constituent components expressed in percentage terms, so that the relative contribution of each component over time can be more easily assessed.

Second, Esteban (2000) suggests estimating the degree to which a single component of the shift-share decomposition can explain the overall differential. More specifically, he advocates regressing the total regional differential on each of the separate components in turn and examining the coefficients and explanatory power of each separate regression equation. The proportion of the variance in the total differential 'explained' by the variance in the separate components can be gauged by examining the regression's R^2, while the slope of the regression line and its statistical significance indicates the degree to which changes in any single component are associated with changes in the overall differential.

These two methods of ascertaining the contribution of each component of the regional productivity differential to the aggregate regional differentials are implemented for 1992, 1997 and 2002.

3.2 Results of decomposition analysis – 6-sector industrial classification

Table 5 presents the individual components of the decomposition of the regional productivity differential for the three years under investigation, expressed in terms of percentage differences from the national average for each year. Interpretation of the table is as follows. Reading across the first row, the total regional differential for the North East in 1992 is -5.1% - i.e. productivity in the region is 5.1% below the national average as shown in Figure 3b. The regional differential of -5.1% can be decomposed into three components: -0.1% attributable to the industry mix, -6.2% from the productivity effect, and +1.1% from the allocative component. Thus, even if each sector in the North East had the national average productivity for that sector,

Table 5: Decomposition of relative productivity differentials, 1992-1997-2002

year	region	total differential %	industry mix %	productivity effect %	allocative component %
1992	North East	-5.1	-0.1	-6.2	1.1
	North West	-4.6	0.0	-4.8	0.1
	Yorkshire and the Humber	-6.3	1.6	-8.2	0.3
	East Midlands	-5.1	3.9	-9.5	0.4
	West Midlands	-7.1	3.4	-10.5	0.0
	East	14.5	0.1	14.3	0.0
	London	9.3	-4.1	15.5	-2.1
	South East	5.6	-1.8	7.1	0.4
	South West	-8.1	0.2	-7.8	-0.6
	Wales	-6.0	1.4	-7.7	0.3
	Scotland	0.1	-0.2	-0.2	0.5
	Northern Ireland	-8.8	2.2	-14.0	2.9
	standard deviation	*7.9*	*2.4*	*10.3*	*1.0*
1997	North East	-12.8	0.1	-14.4	1.5
	North West	-7.5	-0.1	-7.5	0.0
	Yorkshire and the Humber	-8.2	0.8	-9.8	0.8
	East Midlands	-5.9	2.9	-9.2	0.4
	West Midlands	-9.5	3.5	-12.1	-0.9
	East	16.8	-0.3	17.1	0.0
	London	12.4	-3.1	20.2	-4.7
	South East	10.1	-1.6	12.0	-0.2
	South West	-9.8	0.5	-10.3	-0.1
	Wales	-6.8	1.1	-8.2	0.3
	Scotland	-0.6	0.1	-1.0	0.3
	Northern Ireland	-9.6	0.7	-11.9	1.7
	standard deviation	*10.6*	*2.0*	*13.2*	*1.9*
2002	North East	-10.4	-0.7	-12.2	2.5
	North West	-9.4	-0.8	-8.2	-0.4
	Yorkshire and the Humber	-7.4	0.6	-8.9	0.9
	East Midlands	-6.3	2.0	-8.8	0.6
	West Midlands	-6.2	1.9	-8.3	0.2
	East	19.9	0.3	19.9	-0.3
	London	10.7	-1.9	15.6	-3.0
	South East	10.6	-0.3	11.0	-0.1
	South West	-11.0	0.4	-11.6	0.2
	Wales	-8.3	0.0	-8.6	0.3
	Scotland	-3.8	0.5	-4.5	0.2
	Northern Ireland	-14.5	-0.2	-16.3	2.0
	standard deviation	*11.1*	*1.2*	*12.5*	*1.4*

productivity in the North East would be still 0.1% below the national average because of the sectoral composition of employment in the region. Similarly, if the sectoral composition of the region was equal to the national average (so that the employment

share of each sector mirrored that at the national level), productivity in the region would be 6.2% below the national average because the majority of sectors in the region tend to perform poorly. This can be seen from the detailed tables in Annex C. In Table C1 for 1992, the performance of the North East's Distribution and Marketed Services sectors, for example, are ranked 10th and 11th respectively (amongst the 12 countries and regions). Finally, the allocative component of +1.1% indicates that the region tends to be slightly more specialised in those sectors where its productivity is higher than the national average for that sector (and de-specialised in those sectors where it does comparatively poorly relative to the national average for that sector). Overall, however, it is clear that the large negative productivity effect dominates the overall differential for the North East region.

This pattern of the contributions of each component to the aggregate negative differential for the North East can be compared to London, for example. In 1992, the aggregate productivity differential for London of +9.3% above the national average can be broken down into -4.1% from its industry mix, +15.5% from the productivity effect and -2.1% from the allocative component. Thus London is disadvantaged by its industry mix. At sectoral productivities equal to their national averages, the overall differential is reduced by 4.1% because of the sectoral composition of employment in the region. Table C1 shows that in 1992, London was ranked 12th (i.e. bottom) in terms of its employment share in the two most productive sectors nationally - Primary and utilities and Manufacturing[16]. Counterbalancing this, London has a large productivity component which indicates that its productivity would be 15.5% above the national average if its sectoral distribution of employment exactly matched the national picture. As shown in Table C1, it is the most productive region (ranked 1st) for three of the six sectors (Primary and utilities, Manufacturing and Distribution), while none of the other three sectors are ranked lower than 6th. Overall, therefore, all sectors in London tend to perform at or above the national averages. Finally, the allocative component is -2.1% suggesting that London is not taking advantage of specialising in the sectors where it is most productive, relative to the national average. This can be seen clearly from Table C1 - in terms of productivity, while

[16] Off-setting this (slightly) is the fact that it has the highest regional share (ranked 1st) of Marketed services which is the third most productive sector

London is ranked 1st in both Primary and utilities and Manufacturing, as noted above, it has the lowest share of employment in these two sectors of any region. Thus it is relatively *de*-specialised in precisely those sectors in which it is performing best relative to the national average. Hence the overall regional productivity differential in London is moderated by the fact that it has a low share of employment in the most productive sectors, and also has low shares in those sectors where, relative to the national average, it tends to perform better. These two factors - the industry mix and allocative components - serve to offset the large positive productivity differential arising from the fact that all sectors in London are performing above the national average.

As can be seen from the standard deviations at the bottom of the columns for each component of the differential in Table 5, there is considerably more variation in the productivity effect than in the industry mix or allocative component. Thus, it would appear that the productivity effect dominates in the overall regional productivity differentials, and this is confirmed using the two summary methods suggested by Esteban (2000). Table 6 presents the variance decomposition for each year, while Table 7 presents the results of the regressions of the overall differential on each separate component. As can be seen from Table 6, there is actually more variation in the productivity effect than between the regions as a whole, such that the negative covariance term mitigates its impact on the overall regional productivity differential. That is, productivity differentials between countries and regions would be even greater if it was not for the fact that those regions with higher aggregate productivity also tend to be those with low shares in the more productive sectors, and also tend to be de-specialised in the sectors where they have a comparative advantage relative to the national average. The overall spatial distribution of employment is therefore clearly sub-optimal in terms of aggregate productivity.

Table 6: Variance decomposition of productivity differentials, 1992-1997-2002: 6-sector classification

year	industry mix component	productivity effect	allocative component	covariance term	total
1992	8.4%	166.9%	2.3%	-77.5%	100%
1997	3.1%	149.4%	2.6%	-55.1%	100%
2002	1.0%	123.8%	1.6%	-26.4%	100%

Table 7: Contribution of each component to overall differentials, 1992-1997-2002

year	parameter	industry mix	productivity effect	allocative component
1992	intercept	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)
	slope	-2.235** (0.832)	0.754*** (0.056)	-3.090 (1.857)
	R^2	0.4190	0.9477	0.2169
	AIC	-124.64	-153.54	-121.06
	BIC	-123.67	-152.57	-120.09
1997	intercept	-0.000 (0.001)	-0.000 (0.000)	-0.001 (0.001)
	slope	-3.681** (1.373)	0.806*** (0.044)	-3.428* (1.618)
	R^2	0.4181	0.9704	0.3098
	AIC	-115.03	-150.79	-112.99
	BIC	-114.06	-149.82	-112.02
2002	intercept	-0.001 (0.001)	0.000 (0.000)	-0.000 (0.001)
	slope	-2.303 (3.003)	0.890*** (0.040)	-4.823** (1.981)
	R^2	0.0555	0.9797	0.3722
	AIC	-105.91	-152.02	-110.81
	BIC	-104.94	-151.05	-109.84

Notes

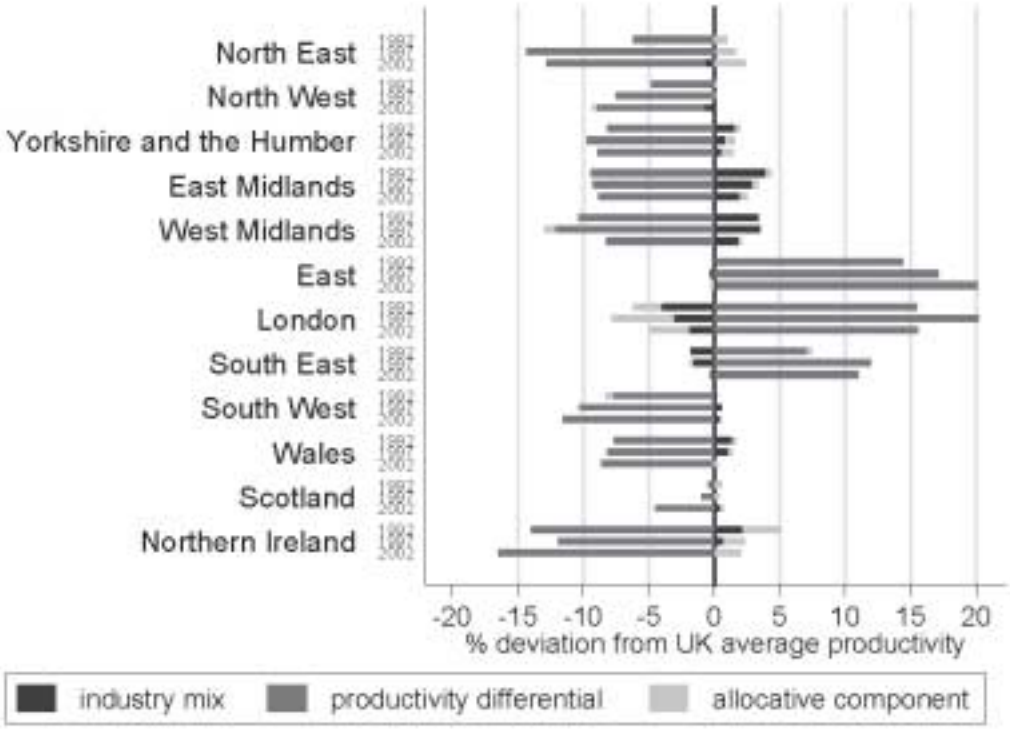
1. *, **, *** denotes statistically significant at 10%, 5% and 1% respectively. Standard errors for coefficients are in parentheses.
2. R^2 is the usual coefficient of determination. AIC and BIC are standard model selection criteria (the Akaike Information Criterion and Bayesian (Schwartz) Information Criterion) defined as: AIC = -2logl+2k and BIC = -2logl+klogN. Smaller values of AIC and BIC indicate a 'better' model.

Figure 7 displays the decomposition for 1992, 1997 and 2002. The dominance of the productivity effect is clearly evident from this figure. Moreover, the inverse relationship between the productivity effect and the industry mix and allocative components is also apparent, especially for East Midlands, West Midlands, London and Northern Ireland. All four of these regions would have larger differentials relative to the national average (East Midlands, West Midlands and Northern Ireland would be more negative, and London would be more positive) but for the off-setting impact of the industry mix and allocative components.

This result is confirmed by the regression analysis presented in Table 7. The model selection criteria - AIC, BIC and R^2 – all indicate that the productivity effect can account for the overall regional productivity differential much better than the industry mix or allocative components. On its own, it can 'explain' 95% or more of the variation in the overall differential. The regression coefficient on the productivity effect

is positive and significant at the 1% level. It is also reasonably close to unity suggesting that there is close to a one-to-one relationship between increases in the productivity effect and increases in the aggregate regional productivity differential.

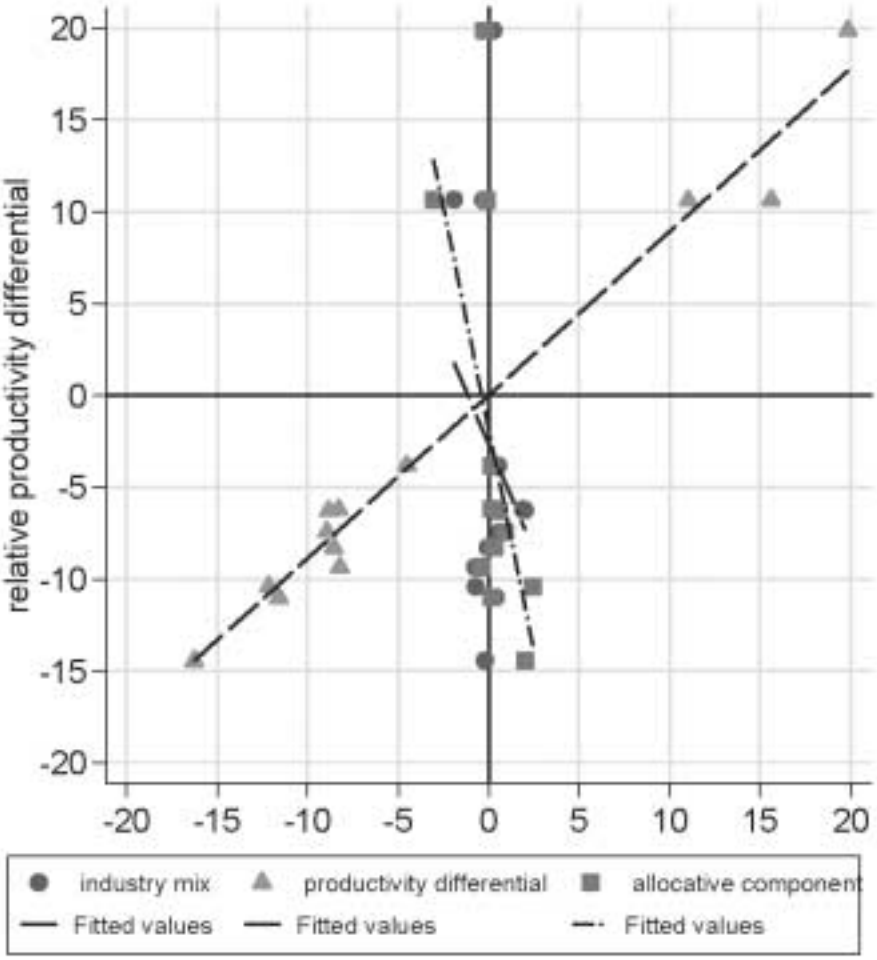
Figure 7: Decomposition of spatial productivity differentials, 1992-1997-2002



Note:
The chart shows each component's separate contribution to the aggregate relative spatial differential. The sum of the positive and negative values equals the total relative spatial differential.

The other two components - the industry mix and the allocative component - display much weaker relationships with the aggregate regional productivity differential. The regression coefficients are negative which confirms the findings above that the most productive countries and regions tend to be de-specialised in the most productive sectors nationally, and also de-specialised in those sectors where they have a comparative productivity advantage. However, some of the regression coefficients are insignificantly different from zero.

Figure 8: Regressions of relative spatial productivity differentials on separate components, 2002



The correlation between each of the three components (industry mix, productivity effect and allocative component) and the overall regional productivity differentials for 2002 is shown in Figure 8. Separate regression lines are plotted for each of the three components against the overall regional productivity differential – these correspond to the results presented in the bottom panel of Table 7. Figure 8 shows even more clearly that it is the productivity effect that shapes the overall pattern of regional productivity differences rather than the industry mix or allocative component. There is an almost one-to-one positive relationship between the productivity effect and the relative productivity differential. In contrast, there would appear to be only a weak (and inverse) relationship between the industry mix, and the allocative component and the relative productivity differential.

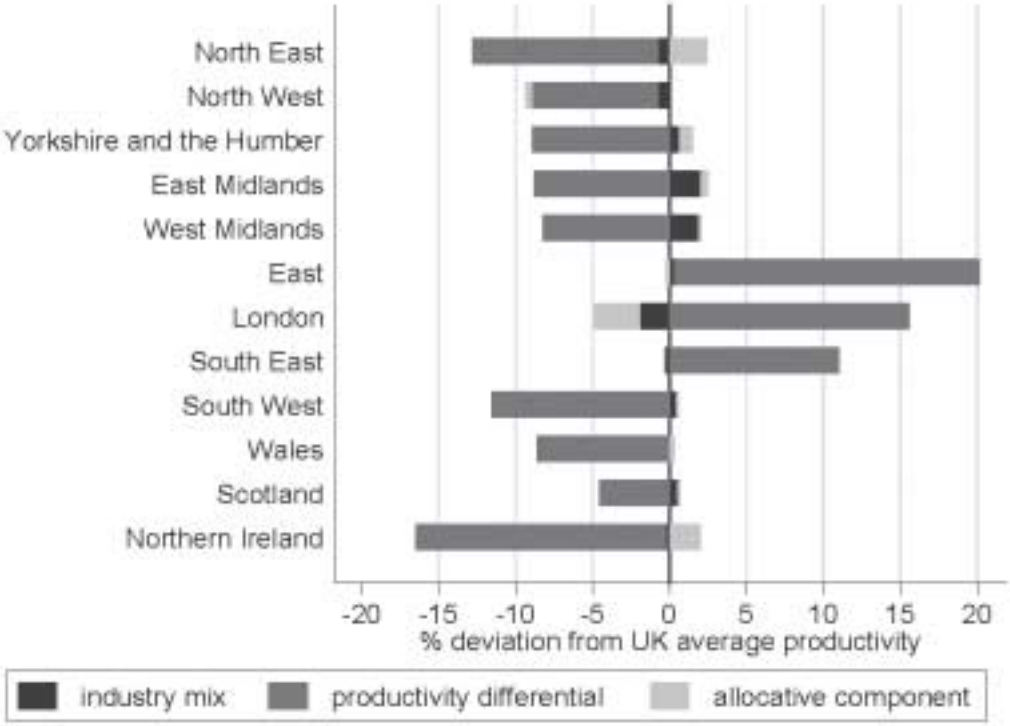
3.3 Analysis for the 14-sector and 25-sector industrial classifications

All of the above analysis for the 6-sector industrial classification was repeated for the 14-sector and 25-sector sectoral classifications to see to what extent differences across sub-sectors may explain the patterns observed. Essentially, the results are very similar to those presented above for the 6-sector classification. In all cases, the productivity effect dominates, while the contribution of industry mix and allocative components to the overall regional productivity differential remains small.[17]

Table 8: Variance decomposition of productivity differentials, 2002: 6, 14 and 25-sector classifications

sectoral classification	industry mix component	productivity effect	allocative component	covariance term	total
6 sectors	1.0%	123.8%	1.6%	-26.4%	100%
14 sectors	2.7%	109.2%	1.7%	-13.6%	100%
25 sectors	2.8%	103.1%	1.7%	-7.6%	100%

Figure 9a: Decomposition of spatial productivity differentials, 2002: 6-sector classification



[17] To some extent, this result is a little surprising since at a more disaggregate sectoral classification, there is less spatial variation, and hence the industry mix term would be expected to become rather more important.

To illustrate, the results of the variance decomposition for 2002 for the 14-sector and 25-sector industrial classifications are presented in Table 8 together with the 6-sector decomposition repeated from Table 6 for comparison. As can be seen, almost all of the regional productivity differential can be attributed to the productivity effect, rather than absolute or relative specialisation in those sectors which are most productive.

This is confirmed in Figure 9a, 9b and 9c which present for each of the 6-, 14- and 25-sector classifications, respectively, the contributions of each component to the aggregate differential for each region in 2002. The productivity effect dominates whichever sectoral classification is selected, although there is a slightly stronger industry mix component once the more detailed classification of industry is used.

Thus, the results presented above for the 6-sector classification are not a consequence of sectoral heterogeneity being disguised by the broad sectoral groupings; at least as examined at the 25-sector classification level. Rather, it would appear that country and regional differences in output per person in employment are primarily due to some areas having higher productivity in most sectors rather than because of their economic structures.

Figure 9b: Decomposition of spatial productivity differentials, 2002: 14-sector classification

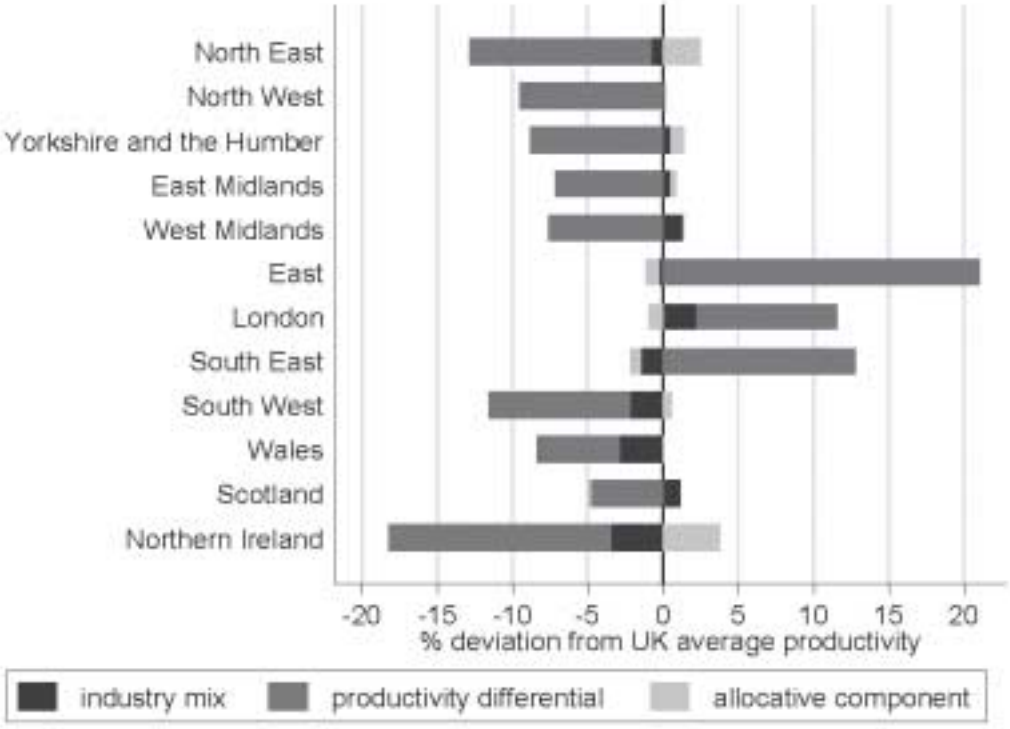
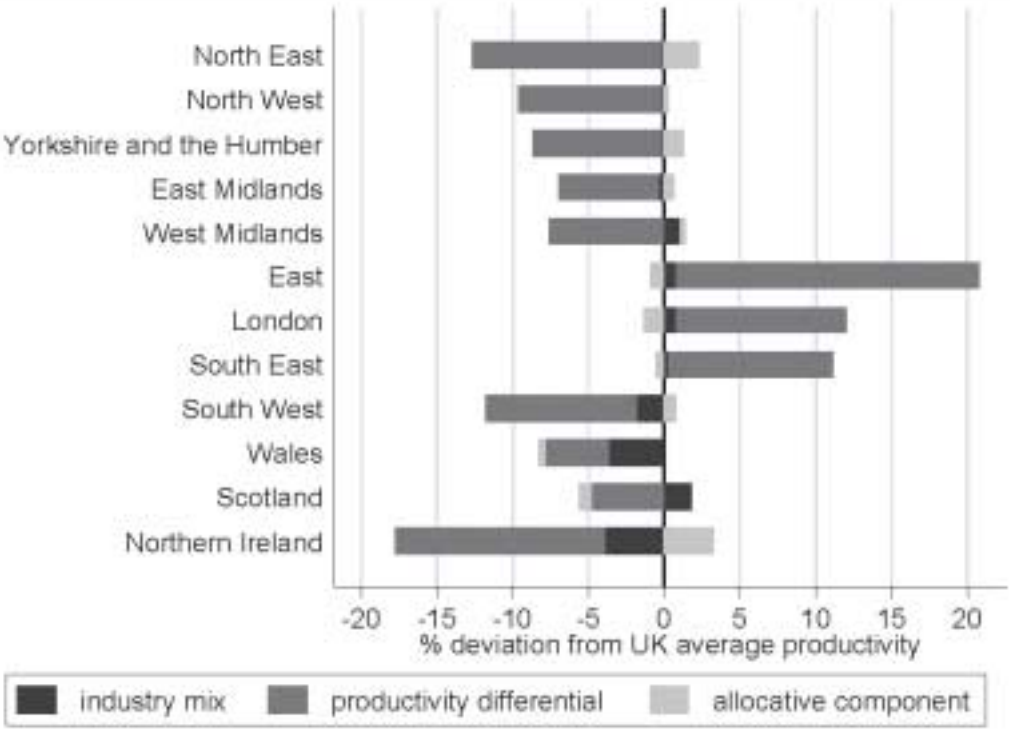


Figure 9c: Decomposition of spatial productivity differentials, 2002: 25-sector classification



3.4 Discussion, caveats and proposals for further research

The extended shift-share decomposition presented above reveals that essentially all of the regional productivity differentials can be attributed to a productivity effect rather than industry mix or sectoral specialisation. That is, London and the rest of the south east do not have higher productivity because they are specialised in sectors which have high productivity (either in absolute or relative terms), but rather, they tend to have higher productivity in most or all sectors relative to the national average.

This result is similar to that found by Esteban (2000) for the EU at the NUTS 2 level[18]. He provides results for a number of different data sets which have different coverage of countries (only sometimes including the UK), different years (1986 and 1989) different sectoral classifications (6 and 17 sectors), and different measures of GVA (at market prices and factor costs). Despite these differences, the results are remarkably consistent in that region-specific productivity differentials – what we have

[18] The size of the NUTS 2 regions varies substantially across the EU, but for the UK, there are 37 such regions, corresponding roughly to counties or groups of counties.

termed here the 'productivity effect' - account for virtually all inter-regional differences in aggregate labour productivity. A similar exercise has been performed more recently by Kamarianakis and Le Gallo (2003). They too use NUTS 2 level data, for the period 1975-2000, for 8 sectors in 15 EU countries. They extend the Esteban (2000) approach by taking careful account of the potential spatial inter-dependencies between the regions. While they find that spatial (and temporal) inter-dependencies are important, they too conclude that the regional productivity component is dominant.

The analysis reported in this paper is based on a coarser spatial disaggregation (NUTS 1 regions) but incorporates a finer sectoral classification (14 and 25 sectors) than used in either the Esteban (2000) or Kamarianakis and Le Gallo (2003) papers. However, the central conclusion is consistent with these two previous studies - the region-specific productivity component is the dominant factor in inter-regional productivity differences[19].

The major advantage in using the *Working Futures* data is that it provides consistent output and employment estimates over the last decade (and, indeed, for the previous decade too, as well as forecasts through to 2012). Such data are not available from official government statistics. However, given that the productivity statistics are derived entirely from model-based forecasts, it may be sensible to repeat the analysis using published National Statistics on actual outturns in order to verify that the same finding was observed. Updated regional GVA estimates at both NUTS 1 (30 sectors) and NUTS 2 (17 sectors) levels have recently been published (August 2003, revised April 2004) following the Nolan Review[20]. For employment, the Labour Force Survey (LFS) could be used since, despite its comparatively small size, it would enable estimates of GVA per *hour*, rather than per *person in employment*, to be calculated given that it contains information on hours worked. Alternatively, the Annual Business Inquiry (ABI) contains information on numbers of full-time and part-

[19] A related study by Morris (2001) finds that differences in regional growth rates in the UK in the late 1990s (in particular, the stronger growth in the South) were not affected by differences in industrial structure between the regions.

[20] The Nolan Review was commissioned to examine the production of regional accounts following the withdrawal of previously published regional GVA data for 1989-1999.

time employees and the average weekly hours worked by each group[21]. However, given the robustness of the main result - that regional productivity differences arise from most or all sectors in a region performing above or below average - it seems unlikely that adjusting for hours worked would radically change the central conclusion. Differences in hours could only be important if they differed systematically between countries and regions more than between sectors.

4. Conclusions

At the NUTS 1 spatial level, for a range of industry classifications, this report has demonstrated that sector mix and specialisation in high productivity sectors account for very little of the regional productivity differentials observed[22]. Rather, most of the interregional variance in aggregate productivity per person can be attributed to productivity differences that are fairly uniform across sectors. That is, most of the difference in productivity between countries and regions can be attributed to the fact that the majority of sectors in some regions have higher labour productivity than in other regions. It is not the sectoral specialisation that has most effect but rather the differential performance of the same sector in different countries and regions. Hence sectors in high performing areas are able to optimise the local factors to achieve better productivity. The higher performing countries and regions can thus provide an upper benchmark that sectors in weaker performing areas can aspire to.

How then might this finding be understood? It seems sectors in high performing countries and regions are able to optimise the local factors to achieve better performance. Clearly, an important factor determining output per worker is the skills that workers have. Thus the sectoral differences in productivity between countries and regions may reflect differences in the occupational - or skills - distribution of

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[21] Of course, ideally, the measures output and employment data would come from the *same* source. This is now feasible with the addition of year averaged employment number to the ABI survey. Daffin and Lau (2002) present some preliminary measures of labour productivity (output per job) for 1998-2000 for 2-digit and 4-digit SIC industries using the ABI.

[22] At the macro level, this is analogous to the finding in Griffith *et al* (2003) that only 10% of the productivity gap between the UK and the US can be attributed to the fact that the UK has a higher share of employment in low productivity sectors.

employment within sectors. For example, it is well known that London and the South East – two regions in which sectors tend to perform uniformly better than their national averages – have higher proportions of individuals educated to degree level and lower proportion with no or few qualifications. Thus the patterns we have documented in sectoral productivity differences across countries and regions may simply reflect the differences in their occupational distribution of employment.

Some research has been conducted which can throw light on this possibility. Rice and Venables (2003) use two measures of individuals earnings – the first based on the wage equations provided by Duranton and Monastiriotis (2002) which take account of individuals' education and experience and the second based on wages of specific occupational groups derived from the NES - to provide evidence that, even controlling for the skills composition of the workforce, considerable variation in output per employee still remains[23]. That is, while high productivity areas do tend to have a larger share of jobs located towards the top of the occupational distribution, much of the variation in output per employee cannot be accounted for by the occupational – or skills – composition of the workforce in the local area. Thus, while some of the differences we have reported are undoubtedly a consequence of occupational composition, regional productivity differentials reflect more than simply differences in the occupational composition of the workforce – there would appear to be real differences in productivity across sectors in different countries and regions.

Other plausible explanations for the tendency for all sectors within certain countries and regions to perform better (or worse) than their national average include the role of spatial differences. Of particular relevance is the work of Ciccone and Hall (1996) for the US and Ciccone (2002) for the EU which finds that population density and productivity are positively correlated. This finding is confirmed by Rice and Venables (2004) for Britain. It may therefore be no coincidence that London and the South East consistently perform better than the other areas given their higher population densities. Cost-of-living effects may also be important too – GVA heavily reflects labour income and this may compensate for regional differences in the cost-of-living

[23] Their analysis is, in fact, at the NUTS 3 level, but their conclusion can be expected to still hold at the more aggregate NUTS 1 level considered in this paper.

– with the differences between London and the rest of the south east as compared to all other regions perhaps particularly relevant. Real output per employee may be more similar if output is adjusted by regional deflators reflect living and also housing costs.

With these considerations in mind, the main result suggests that an investigation of the factors that contribute to inter-regional productivity should focus on differences at the country and regional level - such as infrastructure (communications etc) and other spatial factors, physical and human capital etc – and how these impinge on and enhance the performance of different sectors (see also HMT/DTI, 2001). Certainly, attempts to change the structure of regional economies to enable them to specialise in high-productivity sectors would appear to have little merit given the small contribution to the regional differentials that arise from the industry mix or allocative components. Rather, policies need to be devised to increase the performance across all sectors where these are currently performing below their national average in particular countries and regions. Only then will spatial productivity differentials be narrowed.

Finally, the results can be seen to support and validate the use of regional and sectoral economic strategies in combination to raise the performance of certain areas. It is thus fundamental that the Sector Skills Agreements retain a country and region dimension as well as a sector perspective to raising skills levels and tackling productivity.

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Annex A: Definitions of 6-, 14- and 25-sector classifications

Table A1: 6-sector definitions and employment in 2002

	sector	SIC92 section	SIC92 division	employment (000)
1	Primary and utilities	A,B,C,E	01-05,10-14,40-41	660
2	Manufacturing	D	15-37	3,867
3	Construction	F	45	1,854
4	Distribution	G,H,I	50-64	8,669
5	Marketed services	J,K,O,P,Q	65-74,90-99	7,498
6	Non-marketed services	L,M,N	75,80,85	6,787
	Total			29,336

Table A2: 14-sector definitions and employment in 2002

	sector	SIC92 section	SIC92 division	employment (000)
1	Agriculture, hunting, forestry and fishing	A,B	01-05	443
2	Mining and quarrying	C	10-14	77
3	Manufacturing	D	15-37	3,867
4	Electricity, gas and water	E	40-41	140
5	Construction	F	45	1,854
6	Retail and distribution	G	50-52	5,001
7	Hotels and catering	H	55	1,860
8	Transport, storage and communication	I	60-64	1,808
9	Banking and insurance	J	65-67	1,146
10	Other business services	K	70-74	4,533
11	Public admin and defence	L	75	1,461
12	Education	M	80	2,289
13	Health and social work	N	85	3,038
14	Miscellaneous services	O,P,Q	90-99	1,819
	Total			29,336

Table A3: 25-sector definitions and employment in 2002

		SIC92 division	employment (000)
1	Agriculture	01-02, 05	443
2	Mining and quarrying, utilities	10-14,40-41	217
3	Food, drink and tobacco	15-16	482
4	Textiles and clothing	17-19	247
5	Wood, paper, printing and publishing	20-22	581
6	Chemicals and Non-metallic minerals	23-26	637
7	Metals and metal goods	27-28	497
8	Engineering	29-33	800
9	Transport equipment	34-35	388
10	Manufacturing nes and recycling	36-37	234
11	Construction	45	1,854
12	Sale and maintenance of motor vehicles	50	664
13	Wholesale distribution	51	1,286
14	Other retail distribution	52	3,052
15	Hotels & catering	55	1,860
16	Transport	60-63	1,261
17	Communications	64	547
18	Banking and insurance	65-67	1,146
19	Professional services	70,71,73	734
20	Computing and related	72	548
21	Other business services	74	3,252
22	Public administration and defence	75	1,461
23	Education	80	2,289
24	Health and social work	85	3,038
25	Miscellaneous services	90-99	1,819
	Total		29,336

Annex B: A shift-share decomposition for spatial productivity differentials

In this Annex, we describe how the methodology of shift-share analysis as originally proposed by Dunn (1960) can be extended to the decomposition of inter-regional aggregate productivity differentials. We follow closely the exposition and notation utilised by Esteban (2000).

Let p_i^j be the employment share of sector j, $j = 1,...J$ in region i, $i = 1,...I$, and p^j be the employment share of sector j at the national level. Equivalently, let x_i^j be productivity defined as output per worker in sector j in region i and x^j be productivity in sector j at the national level. Given that aggregate productivity can be expressed as the employment weighted sum of sectoral productivities at national and regional level, we have:

$$x = \sum_j p^j x^j \tag{B1}$$

and

$$x_i = \sum_j p_i^j x_i^j \tag{B2}$$

where x is aggregate national productivity and x_i is productivity in region i.

Esteban (2000) demonstrates that the regional productivity differentials from the national average, $\Delta_i = x_i - x$, can be decomposed into the following three components:

Industry mix

The industry mix component, μ_i, measures the contribution to the regional productivity differential that accrues from region i's specific sectoral composition, assuming that the sectoral productivities in each region are equal to the national average. This is computed as:

$$\mu_i = \sum_j (p_i^j - p^j) x^j \tag{B3}$$

so that μ_i is positive if the region is specialised ($p_i^j > p^j$) in sectors with high productivity and/or de-specialised in sectors with low productivity ($p_i^j < p^j$), and *vice versa*. The industry mix component is therefore that part of the regional productivity

differential that is the consequence of regions being specialised in the most or least productive sectors.

Productivity differential

The productivity differential component, π_i, is the contribution to the regional productivity differential that arises from sectoral differences in productivity between the region and the national average, assuming the region's industry mix is the same as at the national level. This is defined as:

$$\pi_i = \sum_j p^j (x_i^j - x^j) \tag{B4}$$

so that π_i is positive if the region has sectoral productivities above the national average.

Allocative component

The allocative component, α_i, is the contribution to the regional productivity differential that derives from a region being specialised, relative to the national average, in the sectors in which they have above/below average productivity. It is calculated as:

$$\alpha_i = \sum_j (p_i^j - p^j)(x_i^j - x^j). \tag{B5}$$

The allocative component can be interpreted as an indicator of the efficiency in each region in allocating employment to the sectors in which it has comparative advantage. It also measures the covariance between the industry mix and productivity differential.

Thus, the overall gap between regional productivity and the national average, Δ_i, can be additively decomposed into these three components, such that:

$$\Delta_i = x_i - x = \mu_i + \pi_i + \alpha_i. \tag{B6}$$

To gauge the relative contribution of each component to overall regional productivity differentials, Esteban (2000) suggests two approaches, both of which we utilise in this paper. First, he computes the relative weight of the variances of each component in the overall variance in differentials. Using (B6), we can write:

$$\text{var}(\Delta) = \text{var}(\mu) + \text{var}(\pi) + \text{var}(\alpha) + 2(\text{cov}(\mu,\pi) + \text{cov}(\mu,\alpha) + \text{cov}(\pi,\alpha)) \tag{B7}$$

although, as a measure of inequality, the variance is not scale-independent, and hence is less useful for comparisons over time. We therefore also express these contributions in percentage terms so that the relative contribution of each component over time can be more easily assessed. Secondly, Esteban (2000) suggests estimating the degree to which a single component of the shift-share decomposition can explain the overall differential. More specifically, he estimates:

$$\begin{aligned} \Delta_i &= x_i - x = a_\mu + b_\mu \mu_i + \varepsilon_\mu \\ \Delta_i &= x_i - x = a_\pi + b_\pi \pi_i + \varepsilon_\pi \\ \Delta_i &= x_i - x = a_\alpha + b_\alpha \alpha_i + \varepsilon_\alpha \end{aligned} \tag{B8}$$

and examines the coefficients and explanatory power of each equation.

In this paper, we utilise both of these methods to illustrate the contributions and relative importance of each component in explaining the overall regional productivity differentials.

Annex C: Productivity and employment shares by sector and country & region, 1992-1997-2002

Table C1: Productivity and employment shares by sector and country & region: ranking by country & region, 1992

	Primary and utilities		Manufacturing		Construction		Distribution		Marketed services		Non-marketed services		Total	
Productivity by sector and country & region – ranking by country & region														
	prod.	**rank**	**prod.**	**rank**	**prod.**	**rank**	**prod.**	**rank**	**prod.**	**rank**	**prod.**	**rank**	**prod.**	**rank**
North East	0.036	6	0.032	3	0.016	8	0.014	10	0.017	11	0.018	7	0.020	7
North West	0.041	3	0.031	4	0.018	2	0.015	7	0.017	8	0.016	12	0.020	5
Yorkshire/Humber	0.034	7	0.028	9	0.017	7	0.015	9	0.018	7	0.017	9	0.019	9
East Midlands	0.036	5	0.026	10	0.016	9	0.015	6	0.017	10	0.017	10	0.020	6
West Midlands	0.032	8	0.026	10	0.017	4	0.015	8	0.017	9	0.017	11	0.019	10
East	0.040	4	0.029	6	0.020	1	0.019	2	0.029	1	0.019	2	0.024	1
London	0.054	1	0.034	1	0.017	6	0.019	1	0.025	3	0.018	6	0.022	2
South East	0.031	9	0.030	5	0.017	3	0.018	3	0.025	2	0.019	3	0.022	3
South West	0.028	10	0.028	7	0.016	10	0.014	12	0.019	5	0.019	5	0.019	11
Wales	0.025	12	0.032	2	0.015	12	0.014	11	0.018	6	0.017	8	0.019	8
Scotland	0.042	2	0.028	8	0.017	5	0.015	4	0.020	4	0.019	4	0.021	4
Northern Ireland	0.027	11	0.024	12	0.015	11	0.015	5	0.013	12	0.020	1	0.019	12
Total and row rank	**0.035**	**1**	**0.029**	**2**	**0.017**	**5**	**0.016**	**6**	**0.021**	**3**	**0.018**	**4**	**0.021**	
Employment shares by sector and country & region – ranking by country & region														
	share	**rank**	**share**	**rank**	**share**	**rank**	**share**	**rank**	**share**	**rank**	**share**	**rank**	**share**	
North East	3%	10	18%	5	8%	2	27%	11	18%	7	26%	2	100%	
North West	2%	11	19%	4	6%	11	30%	1	19%	5	23%	8	100%	
Yorkshire/Humber	4%	6	20%	3	7%	9	29%	6	18%	8	23%	7	100%	
East Midlands	5%	4	23%	2	8%	4	28%	10	16%	11	21%	12	100%	
West Midlands	3%	8	24%	1	6%	10	28%	9	17%	9	21%	11	100%	
East	4%	7	17%	7	8%	3	30%	3	21%	3	21%	9	100%	
London	1%	12	9%	12	6%	12	30%	5	33%	1	21%	10	100%	
South East	3%	9	13%	11	7%	5	30%	4	23%	2	23%	6	100%	
South West	6%	2	14%	10	7%	6	30%	2	19%	6	23%	5	100%	
Wales	5%	3	18%	6	7%	8	28%	8	16%	10	26%	3	100%	
Scotland	4%	5	15%	9	8%	1	29%	7	20%	4	24%	4	100%	
Northern Ireland	7%	1	17%	8	7%	7	23%	12	13%	12	33%	1	100%	
Total and row rank	**4%**	**6**	**17%**	**4**	**7%**	**5**	**28%**	**1**	**19%**	**3**	**24%**	**2**	**100%**	

Table C2: Productivity and employment shares by sector and country & region - ranking by country & region 1997

	Primary and utilities		Manufacturing		Construction		Distribution		Marketed services		Non-marketed services		Total	
Productivity by sector and country & region – ranking by country & region														
	prod.	**rank**	**prod.**	**rank**	**prod.**	**rank**	**prod.**	**rank**	**prod.**	**rank**	**prod.**	**rank**	**prod.**	**rank**
North East	0.044	4	0.032	8	0.018	10	0.015	12	0.016	12	0.019	7	0.020	12
North West	0.049	2	0.032	6	0.020	7	0.018	6	0.020	9	0.017	10	0.021	7
Yorkshire/Humber	0.043	6	0.032	7	0.021	4	0.017	8	0.019	10	0.018	9	0.021	8
East Midlands	0.040	7	0.030	9	0.018	12	0.019	4	0.020	8	0.017	12	0.022	5
West Midlands	0.038	8	0.027	11	0.021	3	0.017	9	0.021	6	0.017	11	0.021	9
East	0.045	3	0.033	5	0.022	2	0.023	2	0.034	1	0.021	1	0.027	1
London	0.086	1	0.036	2	0.025	1	0.025	1	0.028	3	0.020	4	0.026	2
South East	0.031	11	0.037	1	0.020	6	0.023	3	0.029	2	0.020	2	0.026	3
South West	0.033	9	0.030	10	0.018	11	0.017	10	0.021	7	0.020	5	0.021	11
Wales	0.026	12	0.035	4	0.018	9	0.016	11	0.021	5	0.018	8	0.022	6
Scotland	0.043	5	0.035	3	0.021	5	0.017	7	0.022	4	0.020	3	0.023	4
Northern Ireland	0.031	10	0.026	12	0.020	8	0.019	5	0.018	11	0.019	6	0.021	10
Total and row rank	**0.039**	**1**	**0.032**	**2**	**0.020**	**4**	**0.020**	**5**	**0.024**	**3**	**0.019**	**6**	**0.023**	
Employment shares by sector and country & region – ranking by country & region														
	share	**rank**	**share**	**rank**	**share**	**rank**	**share**	**rank**	**share**	**rank**	**share**	**rank**	**share**	
North East	2%	10	19%	3	7%	3	28%	9	19%	9	25%	3	100%	
North West	2%	11	18%	5	6%	9	30%	3	21%	4	23%	6	100%	
Yorkshire/Humber	3%	7	19%	4	6%	10	30%	2	20%	7	22%	7	100%	
East Midlands	3%	5	23%	2	6%	6	27%	11	19%	10	22%	9	100%	
West Midlands	3%	8	24%	1	5%	11	28%	8	19%	8	20%	11	100%	
East	3%	6	15%	8	7%	1	31%	1	23%	3	20%	10	100%	
London	1%	12	8%	12	4%	12	29%	7	38%	1	20%	12	100%	
South East	3%	9	12%	11	7%	2	30%	4	26%	2	22%	8	100%	
South West	5%	2	15%	9	7%	5	30%	6	21%	5	23%	5	100%	
Wales	4%	4	18%	6	7%	4	28%	10	17%	11	26%	2	100%	
Scotland	5%	3	15%	10	6%	7	30%	5	20%	6	24%	4	100%	
Northern Ireland	6%	1	16%	7	6%	8	24%	12	14%	12	33%	1	100%	
Total and row rank	**3%**	**6**	**17%**	**4**	**6%**	**5**	**29%**	**1**	**21%**	**3**	**23%**	**2**	**100%**	

Table C3: Productivity and employment shares by sector and country & region - ranking by country & region 2002

	Primary and utilities		Manufacturing		Construction		Distribution		Marketed services		Non-marketed services		Total	
Productivity by sector and country & region – ranking by country & region														
	prod.	**rank**	**prod.**	**rank**	**prod.**	**rank**	**prod.**	**rank**	**prod.**	**rank**	**prod.**	**rank**	**prod.**	**rank**
North East	0.049	6	0.038	3	0.020	11	0.019	11	0.019	11	0.018	7	0.022	10
North West	0.067	2	0.035	7	0.020	9	0.020	6	0.023	8	0.016	12	0.023	9
Yorkshire/Humber	0.050	5	0.034	8	0.021	6	0.021	4	0.022	9	0.018	9	0.023	7
East Midlands	0.048	7	0.034	9	0.020	10	0.021	5	0.024	7	0.017	11	0.023	6
West Midlands	0.057	4	0.033	10	0.022	5	0.020	8	0.024	6	0.017	10	0.023	5
East	0.064	3	0.035	6	0.023	1	0.026	1	0.038	1	0.022	1	0.030	1
London	0.097	1	0.040	1	0.023	2	0.026	3	0.031	2	0.019	6	0.028	2
South East	0.034	11	0.040	2	0.023	3	0.026	2	0.030	3	0.021	2	0.028	3
South West	0.040	9	0.032	11	0.020	7	0.019	12	0.022	10	0.020	3	0.022	11
Wales	0.036	10	0.037	4	0.017	12	0.019	10	0.025	4	0.018	8	0.023	8
Scotland	0.047	8	0.036	5	0.023	4	0.020	7	0.024	5	0.019	5	0.024	4
Northern Ireland	0.033	12	0.029	12	0.020	7	0.019	9	0.019	12	0.020	4	0.021	12
Total and row rank	**0.048**	**1**	**0.035**	**2**	**0.022**	**5**	**0.022**	**4**	**0.027**	**3**	**0.019**	**6**	**0.025**	
Employment shares by sector and country & region – ranking by country & region														
	share	**rank**	**share**	**rank**	**share**	**rank**	**share**	**rank**	**share**	**rank**	**share**	**rank**	**share**	
North East	2%	8	16%	4	7%	3	27%	11	19%	10	28%	2	100%	
North West	1%	11	15%	6	6%	9	30%	2	22%	6	25%	6	100%	
Yorkshire/Humber	2%	6	17%	3	6%	8	29%	5	20%	8	25%	5	100%	
East Midlands	3%	5	18%	1	7%	5	29%	9	20%	9	24%	8	100%	
West Midlands	2%	9	18%	2	6%	11	29%	8	22%	7	23%	9	100%	
East	2%	10	14%	7	8%	1	31%	1	25%	3	20%	11	100%	
London	0%	12	7%	12	5%	12	29%	6	40%	1	19%	12	100%	
South East	2%	7	11%	11	7%	7	30%	4	29%	2	21%	10	100%	
South West	4%	3	13%	9	7%	6	30%	3	23%	5	24%	7	100%	
Wales	3%	4	15%	5	7%	4	28%	10	18%	11	28%	3	100%	
Scotland	4%	2	12%	10	6%	10	29%	7	23%	4	25%	4	100%	
Northern Ireland	5%	1	14%	8	7%	2	27%	12	17%	12	31%	1	100%	
Total and row rank	**3%**	**6**	**14%**	**4**	**7%**	**5**	**29%**	**1**	**23%**	**3**	**24%**	**2**	**100%**	

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Skills for Business 1000

Research Report 2
Evaluation of the Trailblazer Phase of the Sector Skills Council Network

Research Report 3
Skills for Business Network – Phase I Evaluation

Research Report 4
Skills for Business 2003 – Survey of Employers

Research Report 5
Skills Pay: The Contribution of Skills to Business Success

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Research Report 10
Skills for Business Network: Phase 2 Evaluation Main Report

Research Report 11
Skills for Business 2004: Survey of Employers

Research Report 12
Skills for Business Network: Phase 2 Evaluation Case Studies

Working Futures: National Report 2003-04

Working Futures: Regional Report 2003-04

Working Futures: Sectoral Report 2003-04

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