# The Productivity Puzzle

## Introduction

Productivity growth is the key contributor to economic growth. In the words of the economist Paul Krugman "*Productivity isn't everything, but in the long run it is almost everything. A country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker*"[1].

In the lead up to the financial crisis, the UK experienced strong growth in productivity; between 1997 and 2010 Gross Value Added per hour was second only to the US and ahead of France, Germany, Italy and Japan[2]. Since 2010 our productivity has stagnated, its not just the UK that has suffered from weak productivity growth, it's across all advanced countries, but in the UK, the weakness is worse, meaning UK workers across every sector, urban and rural are producing less output per hour worked than our competitors in France, Germany and the US. This post crisis growth is known as the 'productivity puzzle' and is said to be one if the most pressing issues facing the UK's economy today.

## What is Productivity and how is it measured

Productivity is defined as the amount of goods and services that a worker produces in a given period of time. A more productive workforce implies each worker is producing more units of goods and services, i.e. more cars per hour or more phone calls per minute.

The Office for National Statistics measures productivity by dividing a measure of output, usually Gross Value Added (GVA[3]) at a Local enterprise Partnership level, by a measure of input. This means its often expressed as output per worker, output per job or output per hour; with the latter being the more conventional approach. Productivity can grow as a result of technological advances or a better educated or more specialised workforce. From a policy perspective, if labour productivity is falling, it could be an indicator that more should be done to improve the delivery of education or job specialisation. Indeed, on a national scale, labour productivity changes are a main driver of economic policy.

Gross Value Added, the measure of output is derived from surveys of employers. The sample size of the surveys means the results and therefore the estimates of productivity that they feed are most robust at a national level and become less reliable as the areas in question become smaller. This issue restricts the types of analysis that can be carried out and the understanding that can be derived from the data at a local level.

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[1] Krugman (1994)

[2] Corry, D. et al. CEP (2011) UK economic performance since 1997, Growth, productivity and jobs http://eprints.lse.ac.uk/47521/1/CEPSP24.pdf

[3] GVA is a measure of the value of goods and services produced within an area

## How has the UK's productivity changed over time?

Figure 1, shows how the UK's productivity has changed over time since 1994. Following years of steady growth, output peaked prior to and fell during the economic downturn. However, due to a strong labour market performance accompanying a relatively weak recovery in output growth, productivity has not returned to its pre-downturn trend. Productivity in Quarter 4 (Oct to Dec) 2018, as measured by output per hour, was 18.3% below its pre-downturn trend – or, equivalently, productivity would have been 22.5% higher had it followed this pre-downturn trend

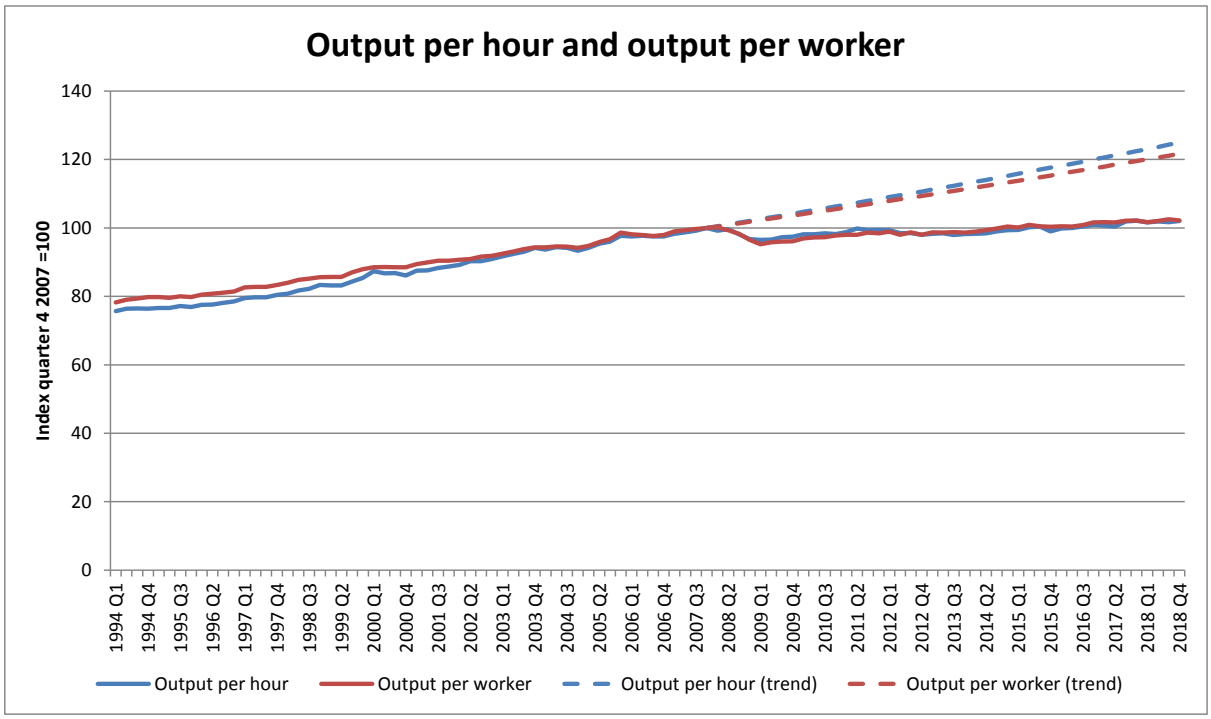


*Figure 1: UK Output per hour and output per worker*[4]

## How does the UK compare to other G7 countries?

The ONS has compared annual estimates of labour productivity for the G7 developed countries (Canada, France, Germany, Italy, Japan, UK and US) up to 2016. Comparability across countries is achieved by using estimates of GDP and labour inputs from a common source (the Statistics Directorate of the Organisation for Economic Co-operation and Development (OECD)), this provides the best data available for international comparisons.

The results showed that when compared with the rest of the G7, the UK had a lower output per worker and output per hour worked in 2016. In terms of GDP per worker the greatest difference was with the US, with a difference of 27.3%, while in terms of GDP per worker the greatest difference was with Germany, with a difference of 26.2%. Japan was the only G7 country that had a lower level of productivity than the UK across both measures.

[4] Labour productivity, UK: October to December 2018

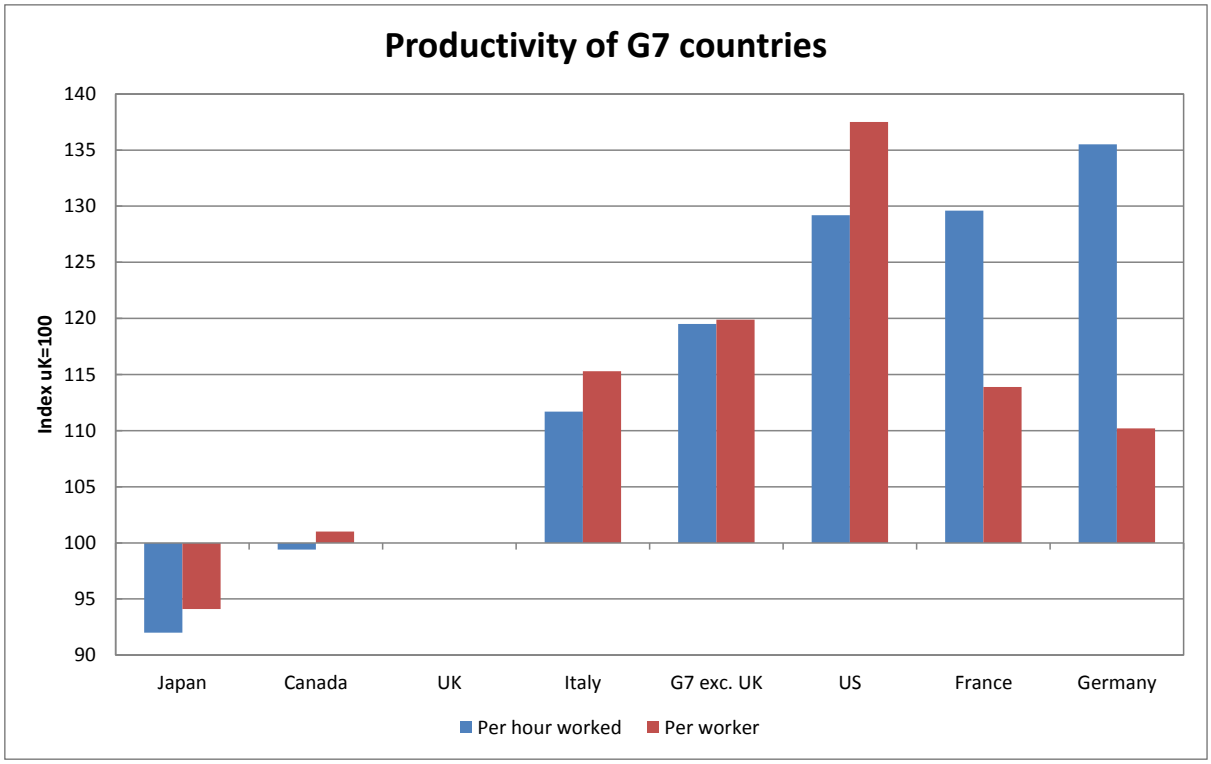


*Figure 2: Productivity of G7 countries, 2016*[5]

Figure 3 expands the analysis to capture all of the available European economies. The UK's productivity lies within the middle of the European economies with a position of 11th out of the 26 nations included in terms of GDP per hour worked and 12th in terms of GDP per persons employed.

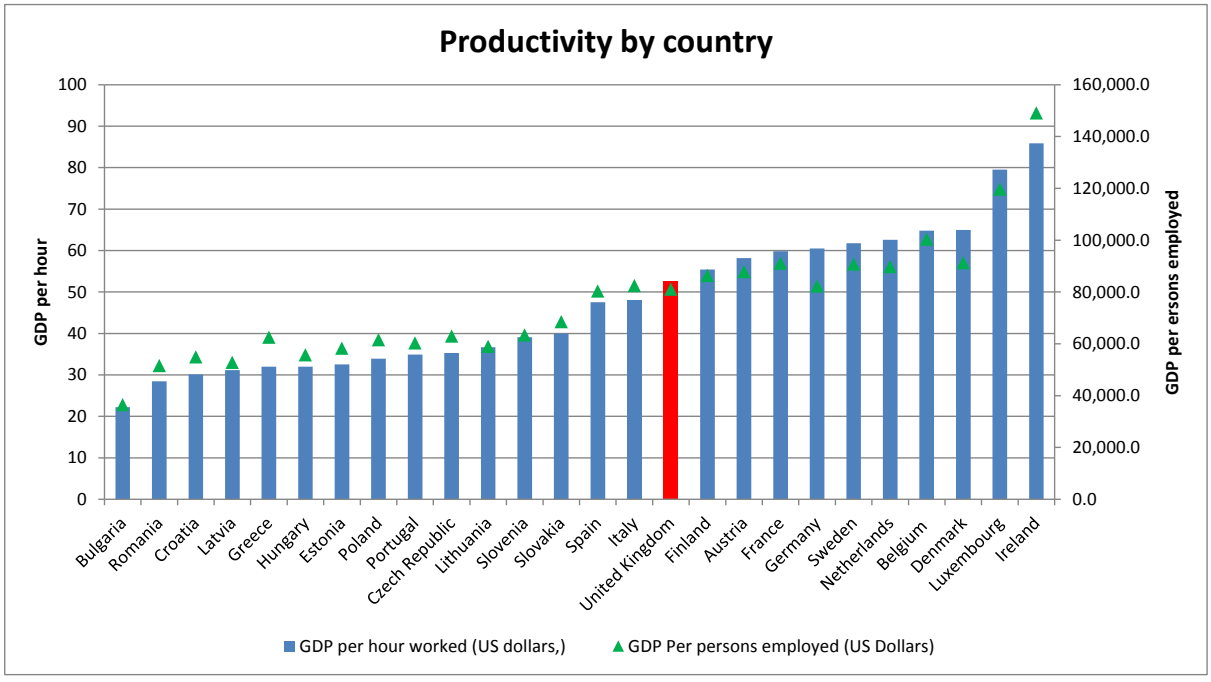


*Figure 3: Productivity by country, 2017*[6]

[5] International comparisons of UK productivity (ICP), final estimates: 2016
[6] OECD, http://stats.oecd.org/Index.aspx?DataSetCode=PDB_LV#

The nature of this productivity gap has generated significant policy interest, but analysis to explain it has been limited due to the availability of comparable data across countries and appropriate exchange rates. Experimental work has recently been carried out that enables us to look at labour productivity for 29 European countries on a nine-industry breakdown. These estimates are principally for 2014. The results of this research indicate that the UK's productivity gap to other leading European G7 economies is replicated at industry level – although the size of that gap varies. Across nine industries the UK has the lowest labour productivity of this group of countries in five industries; and is third in the remaining four categories. Even among the UK's most productive industries measured on this basis – including Production and Financial and Insurance Activities the UK ranks relatively poorly, and there is a substantial gap between the UK and the most productive economy in this group.

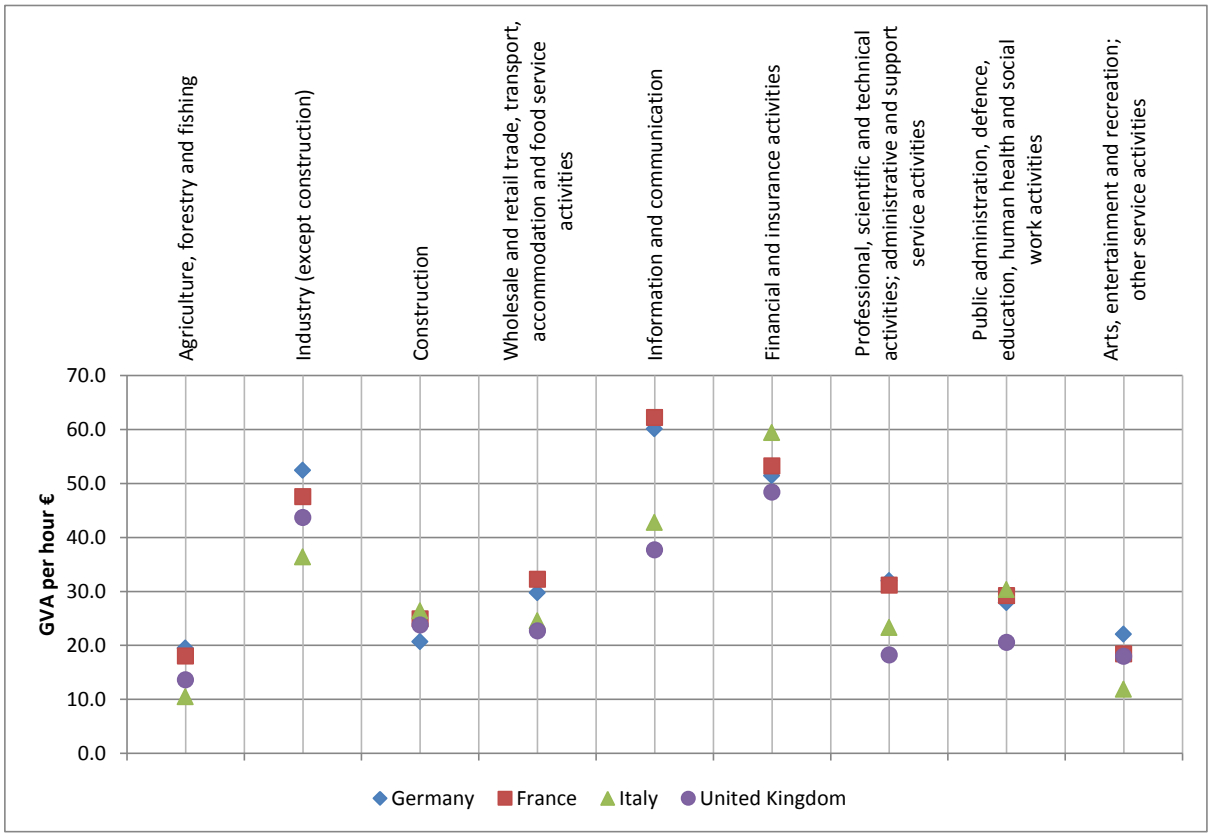


*Figure 4: Output per hour by sector and European G7 countries, 2014*[7]

Figure 5 expanded the analysis to encompass all of the available European economies and shows the UK's productivity lies within the middle of the European economies with an average position of 18th of the 29 nations included. Notable exceptions include relative weakness in the information and communication industry and financial and insurance activities, as well as relative strength in the production industries.

[7] International Comparisons of UK Labour Productivity by Industry

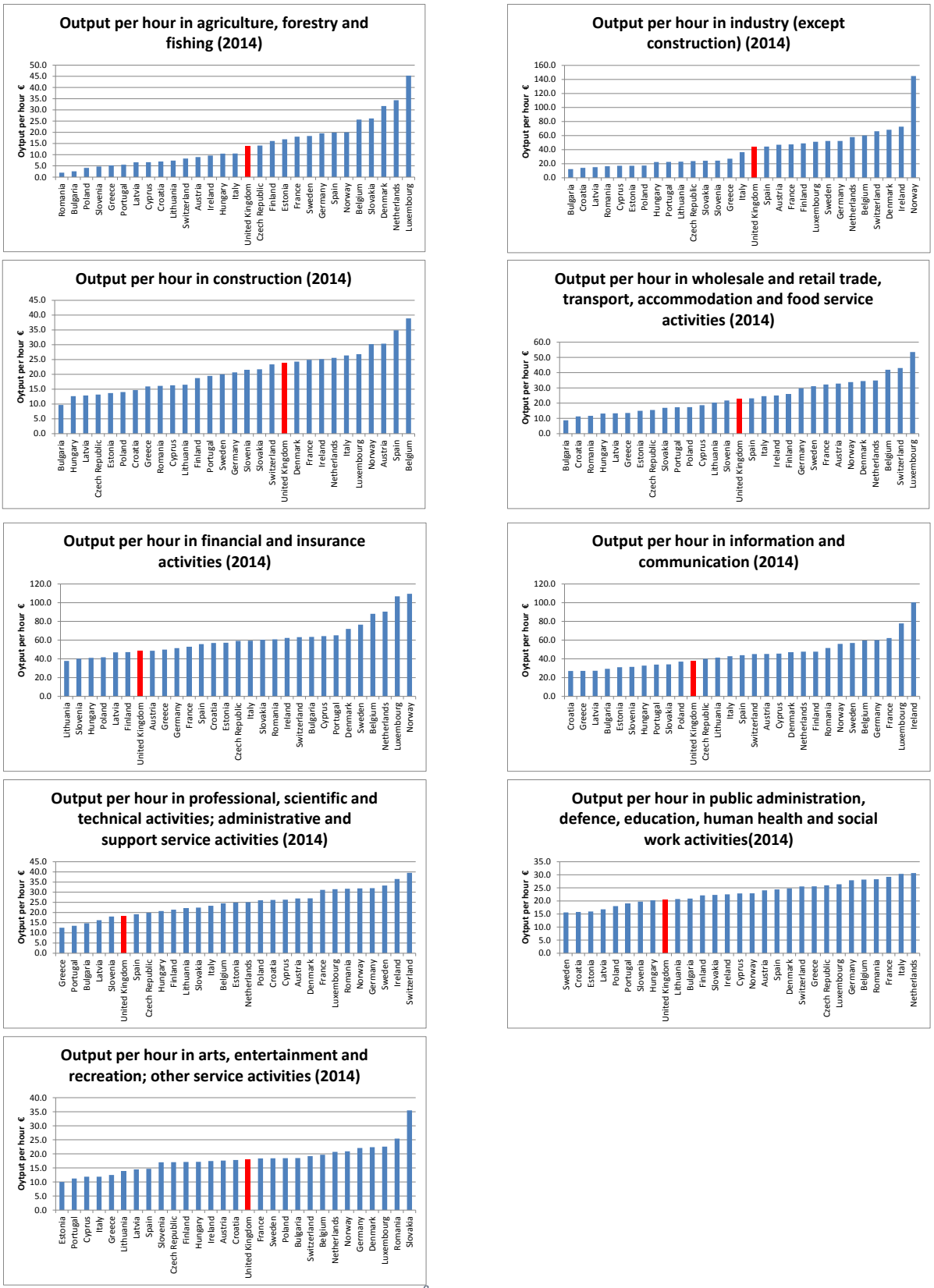


*Figure 5: Output per hour by country and industry, 2014*[8]

[8] International Comparisons of UK Labour Productivity by Industry, 2014

This suggests the explanation for the UK's productivity puzzle is not something that is limited to a few sectors but is instead a more general issue effecting the economy as a whole. There is much debate and little agreement about what this issue may be, some of the main theories include:

1. Investment - physical investment is very low, including in research and development. The UK's infrastructure is rated second worst among G7 members. Moreover, the UK invests in total 1.7 per cent of GDP in private and public R&D. This is below the OECD average of 2.4 per cent and far behind the leading backers of innovation – South Korea, Israel, Japan, Sweden, Finland and Denmark – which contribute over 3 per cent of their GDP to this area[9].
2. Skills - skills have an important impact on productivity but in 2011 to 12 the UK's 16 to 18-year olds were the worst performing on literacy and second worst for numeracy out of 18 OECD countries. We also have a shortage of high-skilled technicians below graduate level, only 10 per cent of adults hold technical education as their highest qualification, placing us 16th out of 20 OECD countries[10].
3. Low interest rates had probably played a role by keeping some heavily indebted, unproductive "zombie" businesses alive. The Bank of England has acknowledged that trade-off, estimating that productivity would have been 1% to 3% higher in the UK had it raised interest rates to pre-crisis levels in the recovery phase. But they believe the consequences – slower income growth and higher unemployment – would have been unacceptable[11].
4. Labour market- Britain came out of the financial crisis with a relatively low unemployment rate, at least compared with other European countries, and the number of those in work is now at a record high. This has led some to suggest that there is a large degree of spare capacity within firms that is bringing down productivity.

## Gloucestershire's productivity

At a local level productivity is measured in terms of gross value added per worker or per hour worked rather gross domestic product.

In 2017 Gloucestershire's GVA per hour worked was £32.2 this was above the South West average (£30.2) but 4.2% below the UK average (£33.6)[12]. Figure 6 shows that when compared to the other 37 Local Enterprise Partnerships, Gloucestershire has a rank of 14 out of 38 (1 having the highest GVA per hour worked). Of those Local Enterprise Partnerships that have a higher GVA per hour worked than Gloucestershire the majority (8 out of 13) are located in London, South East of East England, the exceptions to these are the West of England LEP, Cheshire and Warrington, Swindon and Wiltshire, South East Midlands and Coventry and Warwickshire.

[9] Building our Industrial Strategy
[10] *Ibid.*
[11] http://www.bbc.co.uk/news/business-39332826
[12] Subregional productivity, ONS

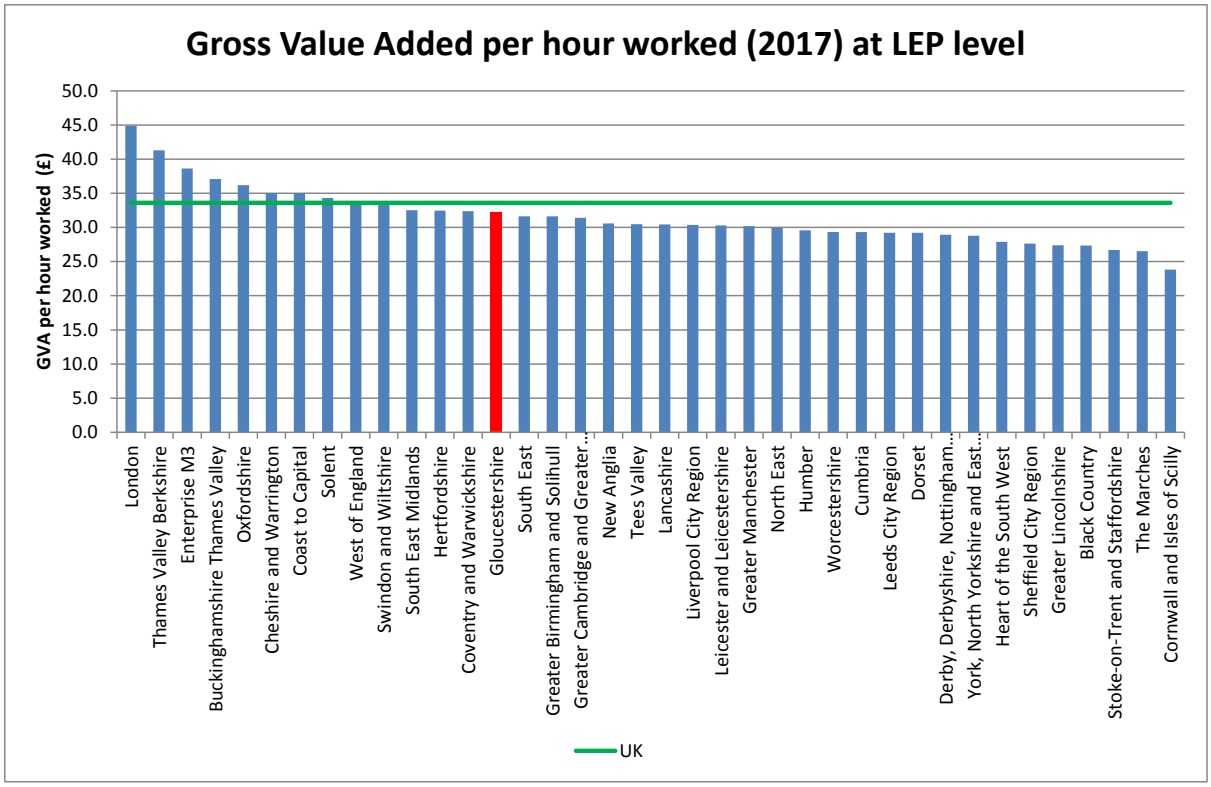


*Figure 6: Gross Value Added per hour worked (2017) at LEP level*[13]

Gloucestershire GVA per filled job stood at £51,664 in 2017, which as with GVA per hour worked was above the South West average (£46,888) but 4.9% below the national average of (£54,330). The picture when compared with other LEP's is also very similar to that observed with GVA per hour worked, with Gloucestershire having a rank of 13 out of 38 (1 having the highest GVA prefilled job). Of those Local Enterprise Partnerships that have a higher GVA per filled job than Gloucestershire the majority (8 out of 12) are located in London, South East of East England, the exceptions to these are the West of England LEP, Cheshire and Warrington, South East Midlands and Coventry and Warwickshire.

[13] Subregional productivity, ONS

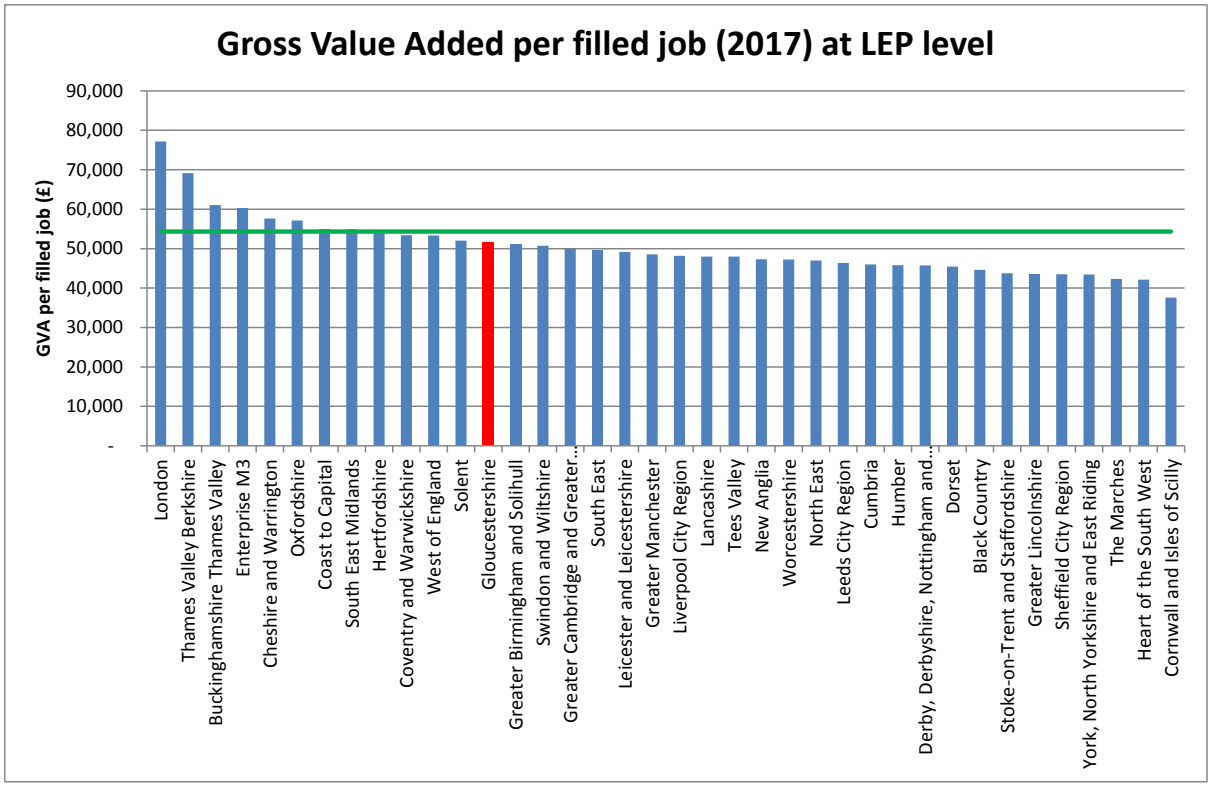


*Figure 7: Gross Value Added per filled job (2016) at LEP level*[14]

## How has Gloucestershire Productivity changed over time?

Figure 8 and Figure 9 show that Gloucestershire has generally followed the national trend in output per hour worked and per worker with growth in productivity prior to the recession, followed by several years of limited growth, which has since been followed by a return to growth. Interestingly in the run-up to the recession and the years directly following the recession, Gloucestershire's productivity grew at a slower rate than nationally, this saw a gap develop between productivity in Gloucestershire and the UK average which had not been present in 2004. However, in recent years this gap has been narrowing in terms of GVA per filled job and is fairly steady in terms of GVA per hour worked, which suggests Gloucestershire's productivity is now growing at a faster rate than nationally. This is supported by Figure 10 and Figure 11, which illustrates the average annual growth rate since 2004/5 and shows that while productivity grew at a lower rate than nationally for a number of year's pre and post recession, it is now growing at a faster rate.

[14] *Ibid.*

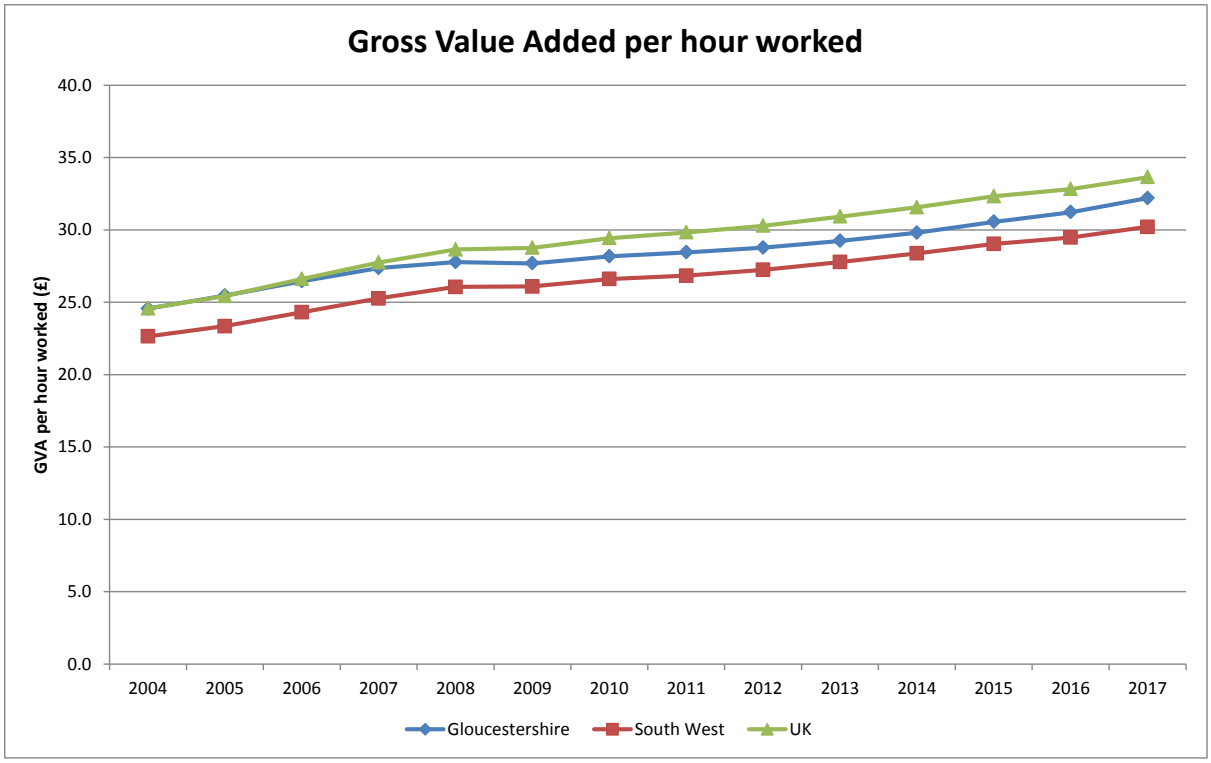


*Figure 8: Gross Value Added per hour worked, 2004-2017*[15]

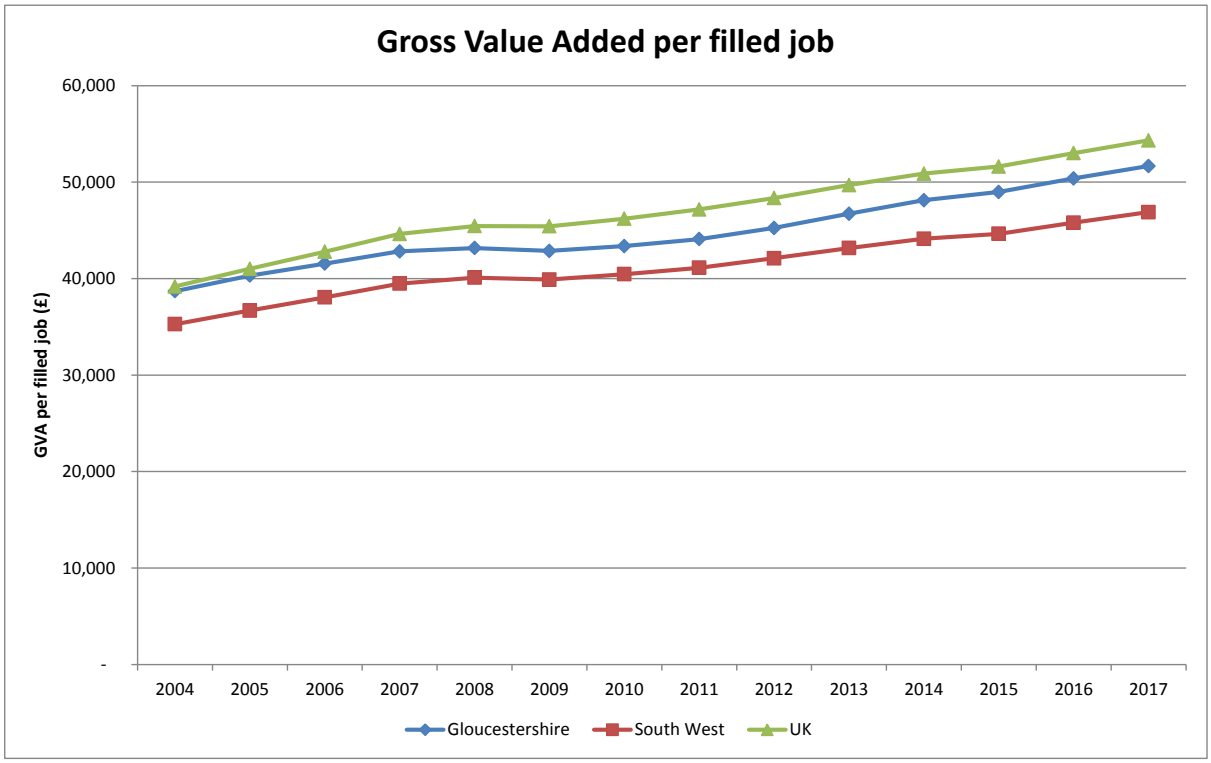


*Figure 9: Gross Value Added per filled job, 2004 -2017*[16]

[15] Subregional productivity, ONS
[16] *Ibid.*

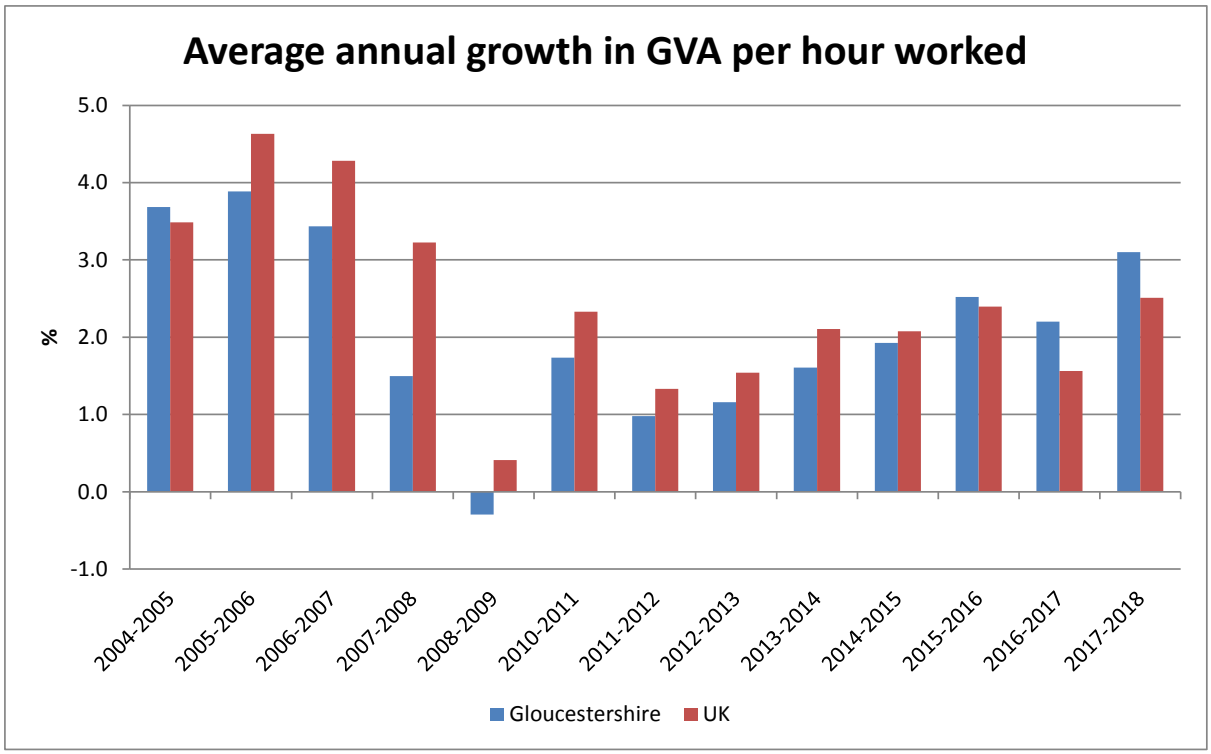


*Figure 10: Average annual growth in GVA per hour worked*[17]

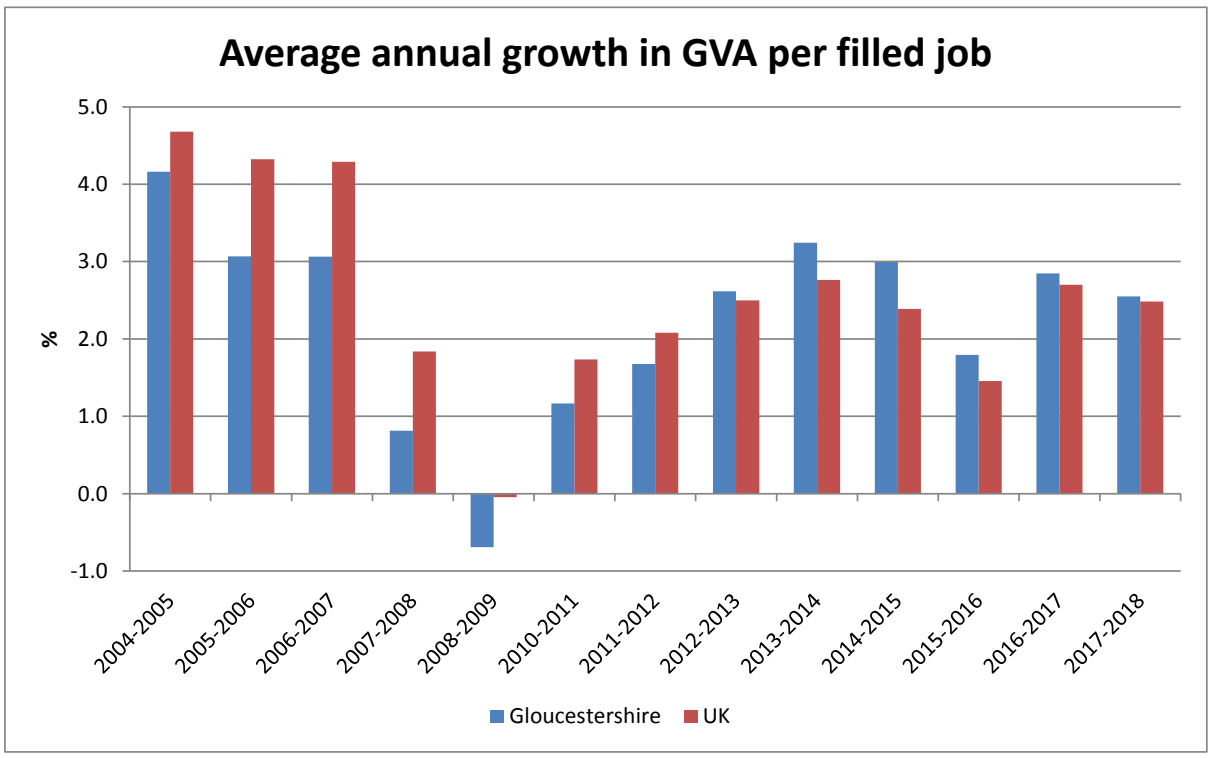


*Figure 11: Average annual growth in GVA per filled job*[18]

[17] *Ibid.*

When compared to the other 37 Local Enterprise Partnerships, Gloucestershire is ranked 12 out of 38 Local Enterprise Partnerships in terms of average annual growth in GVA per hour between 2012 and 2017, as shown in Figure 12. The recent growth in Gloucestershire's GVA per hour means Gloucestershire's position relative to other Local Enterprise Partnerships has improved considerably, with Figure 13 showing that when looking at the more recent period of 2016-17 Gloucestershire ranks 4th out of 38 Local Enterprise Partnerships. Figure 14 and Figure 15 illustrate Gloucestershire's position relative to other Local Enterprise partnerships in regards to growth in GVA per job. Gloucestershire is ranked 7 out of 38 in terms of growth between 2012 and 2017 and 9 out of 38 during the period 2015 and 2016. Gloucestershire's performance in terms of growth in GVA per job was noticeably better than its performance in terms of GVA per hour worked during the period 2011-2016, this is due to a growth in the proportion of people working full-time which was experienced to a lesser extent by other local enterprise partnerships.

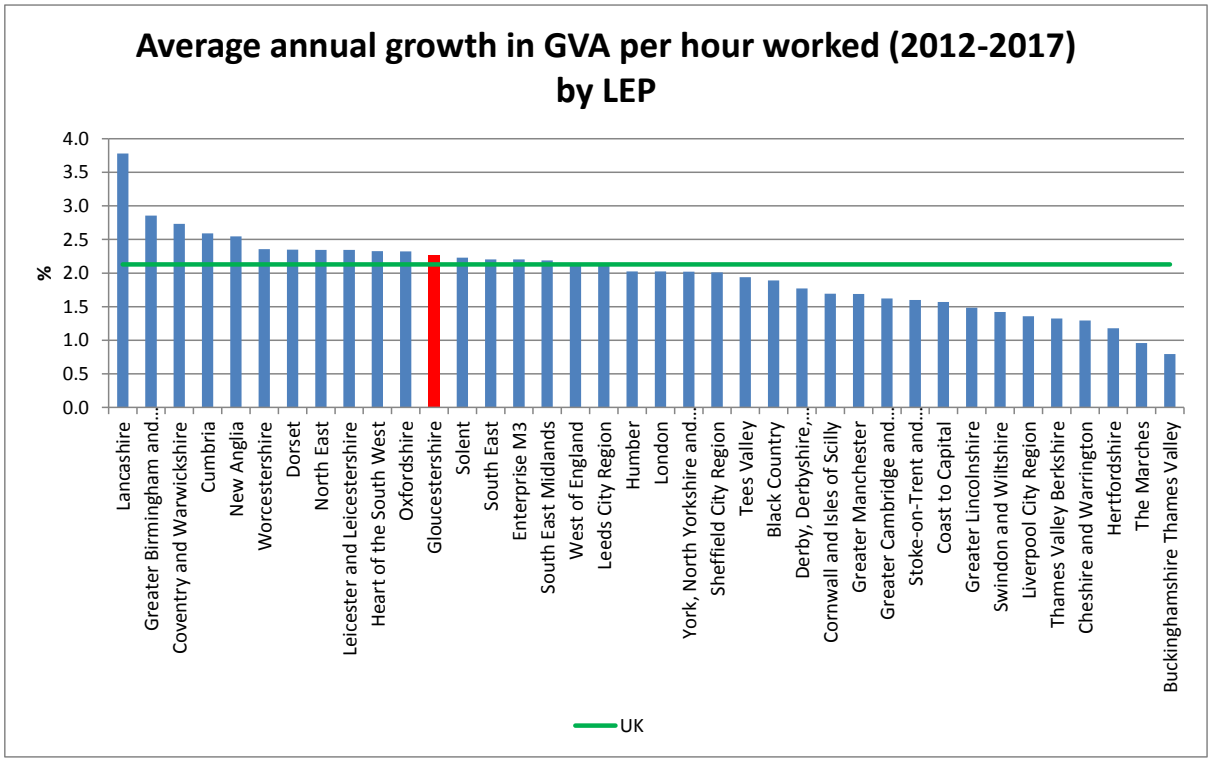


*Figure 12: Average annual growth in GVA per hour 2012-2017 by Local Enterprise Partnership*[19]

[18] *Ibid.*
[19] *Ibid.*

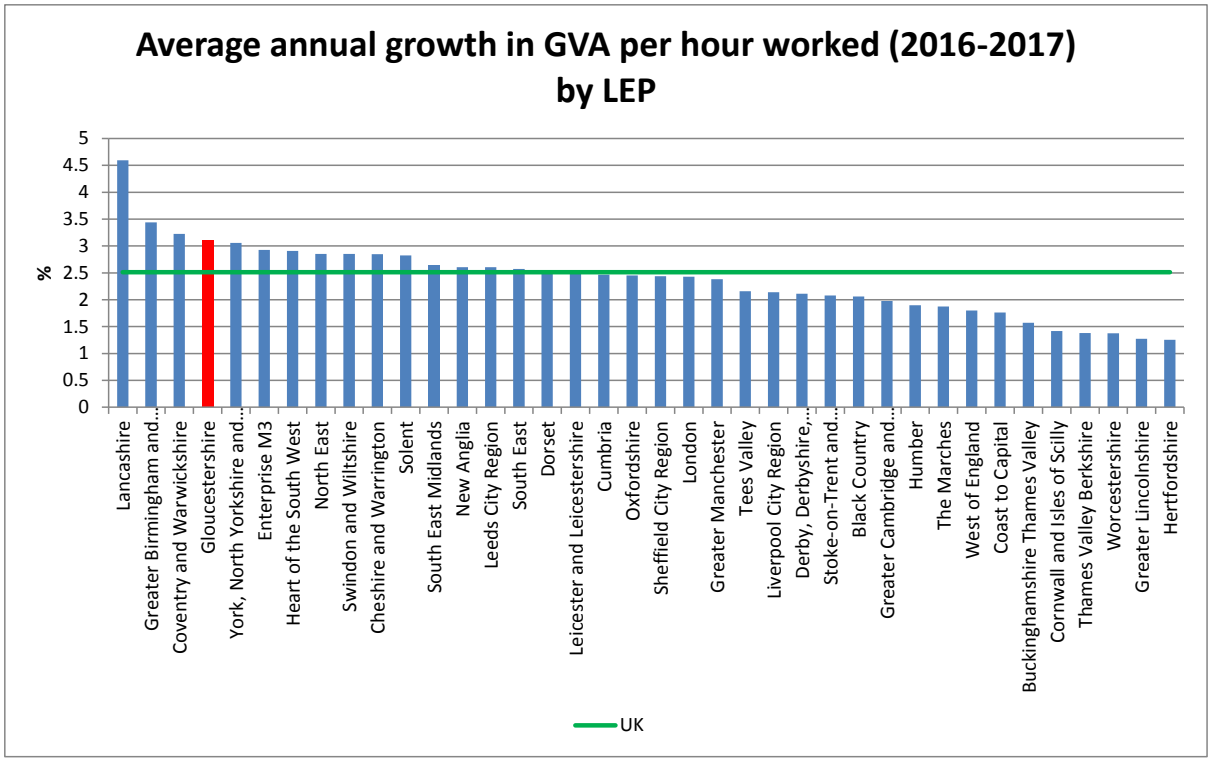


*Figure 13: Average annual growth in GVA per hour 2016-2017 by Local Enterprise Partnership*[20]

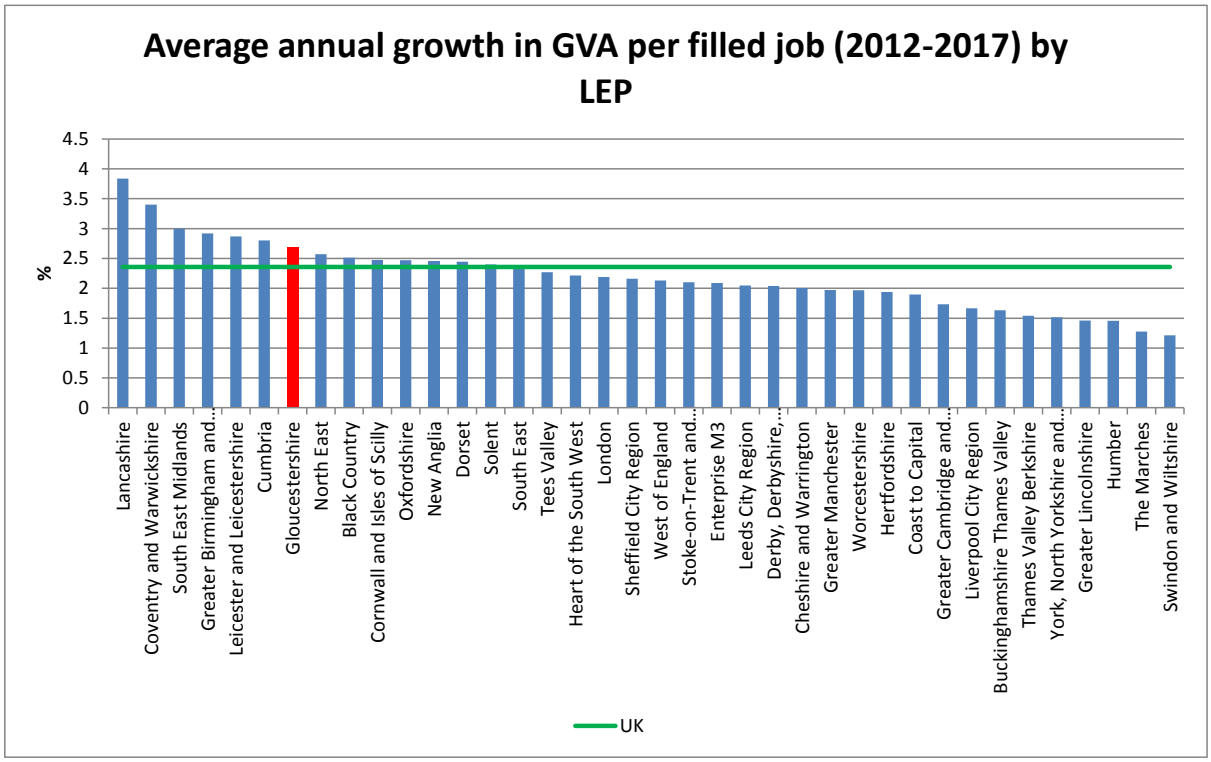


*Figure 14: Average annual growth in GVA per job 2012-2017 by Local Enterprise Partnership*[21]

[20] *Ibid.*
[21] *Ibid.*

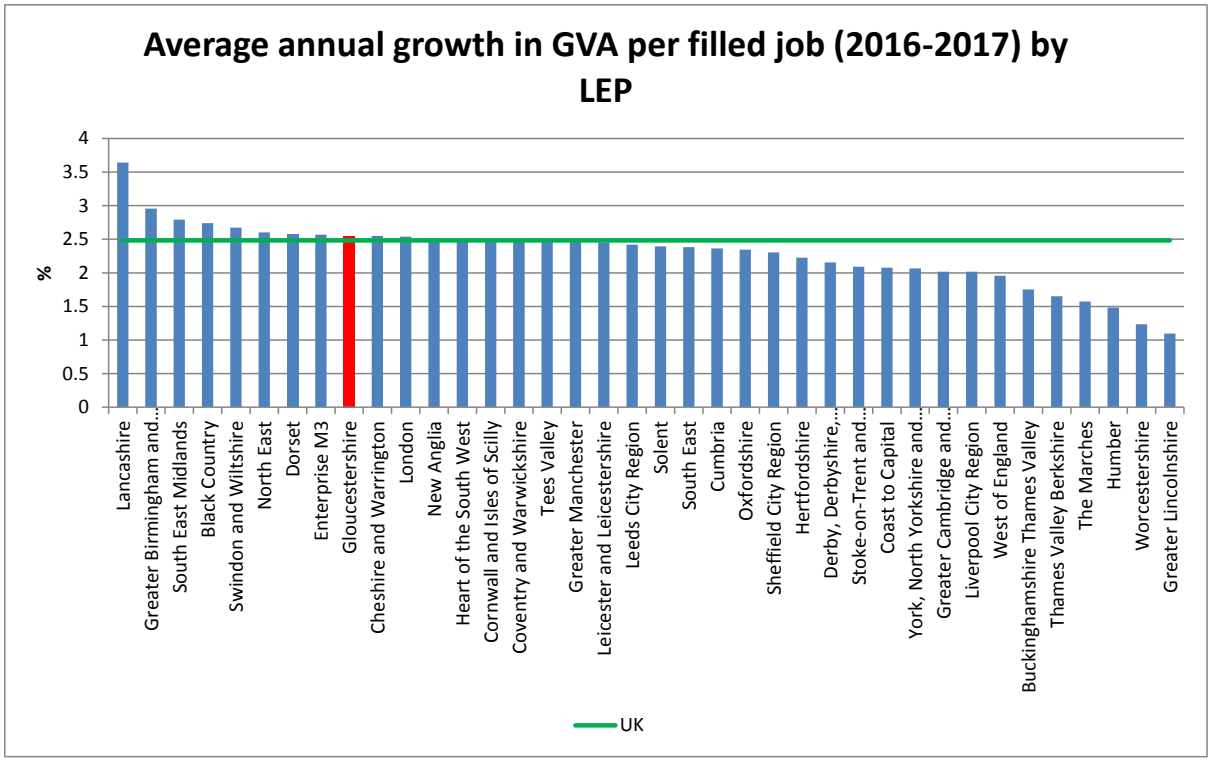


*Figure 15: Average annual growth in GVA per job 2015-2016 by Local Enterprise Partnership*[22]

Gloucestershire's performance relative to other local enterprise partnerships in terms of current levels of productivity per hour and growth rates is shown diagrammatically in Figure 16. The axis on the graph crosses at the average size and rate of growth for all local enterprise partnerships. Gloucestershire sits in the top right quadrant meaning it is exceeding the average for GVA per hour and average growth between 2011 and 2017. There are only five ten enterprise partnerships that exceed the average on both points of consideration.

[22] *Ibid.*

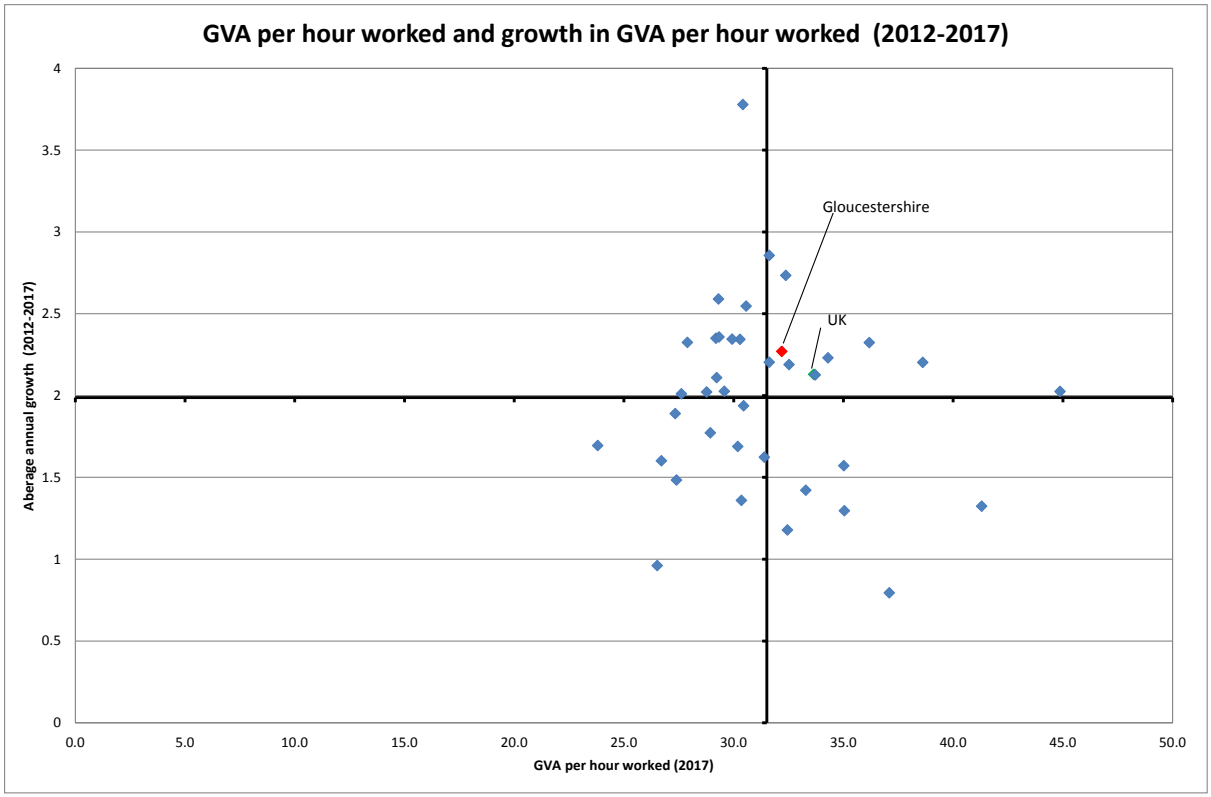


*Figure 16: GVA per hour and growth in GVA per hour (2012-2017)*[23]

Gloucestershire's also compares well when looking at productivity per filled job, with Figure 17 showing that between (2012 -2017) Gloucestershire was one of only a handful of Local Enterprise Partnerships that exceeded the average in terms of growth and GVA per job.

[23] *Ibid.*

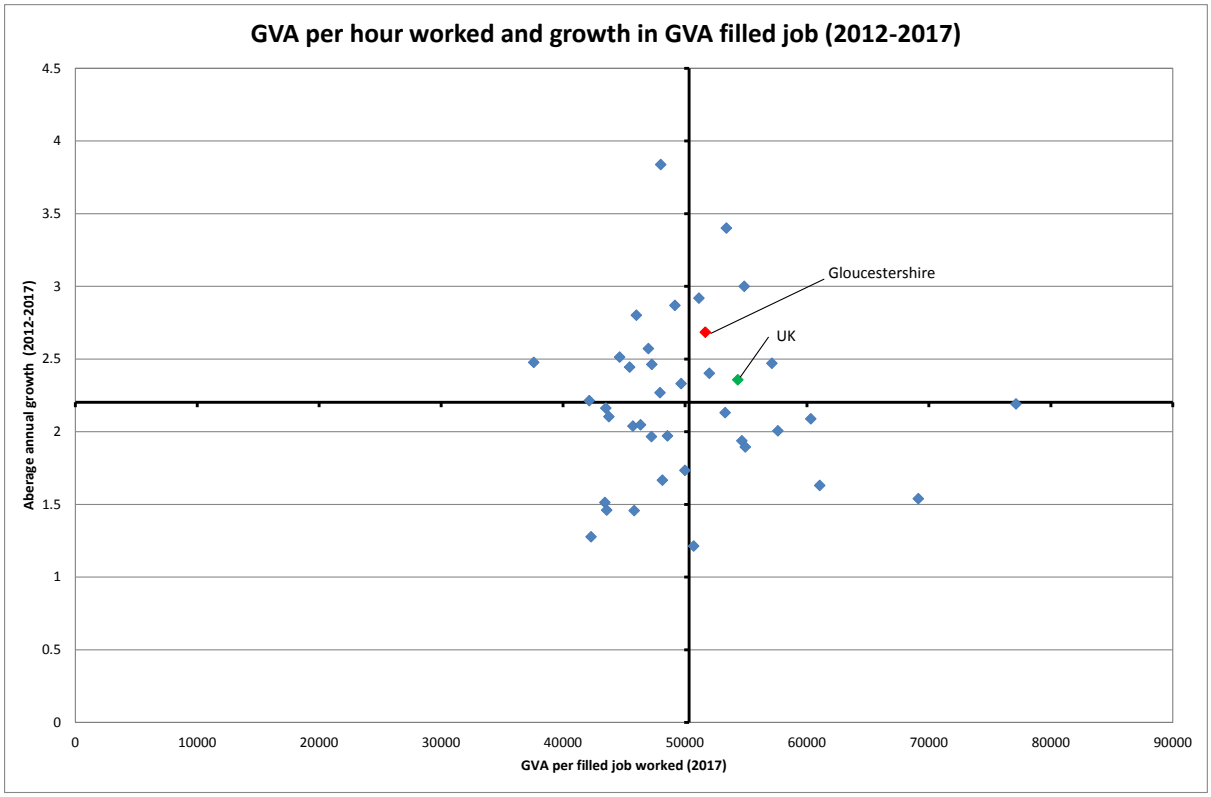


*Figure 17: GVA per job and growth in GVA per job (2012-2017)*[24]

## What's driving Gloucestershire's productivity?

Limited information at a local level means it is not possible to identity which sectors are driving Gloucestershire's productivity growth. However, data does show which sectors have experienced the greatest growth in GVA and higher levels of GVA mean higher productivity if the number of workers and hours remains constant. Figure 18 shows that between 2012 and 2017, all sectors in Gloucestershire experienced growth. The greatest growth was in Agriculture, mining, electricity, gas, water and waste; Construction,; and Other services and household activities, which suggests these sectors may have played a particular role in driving Gloucestershire's productivity growth.

[24] *Ibid.*

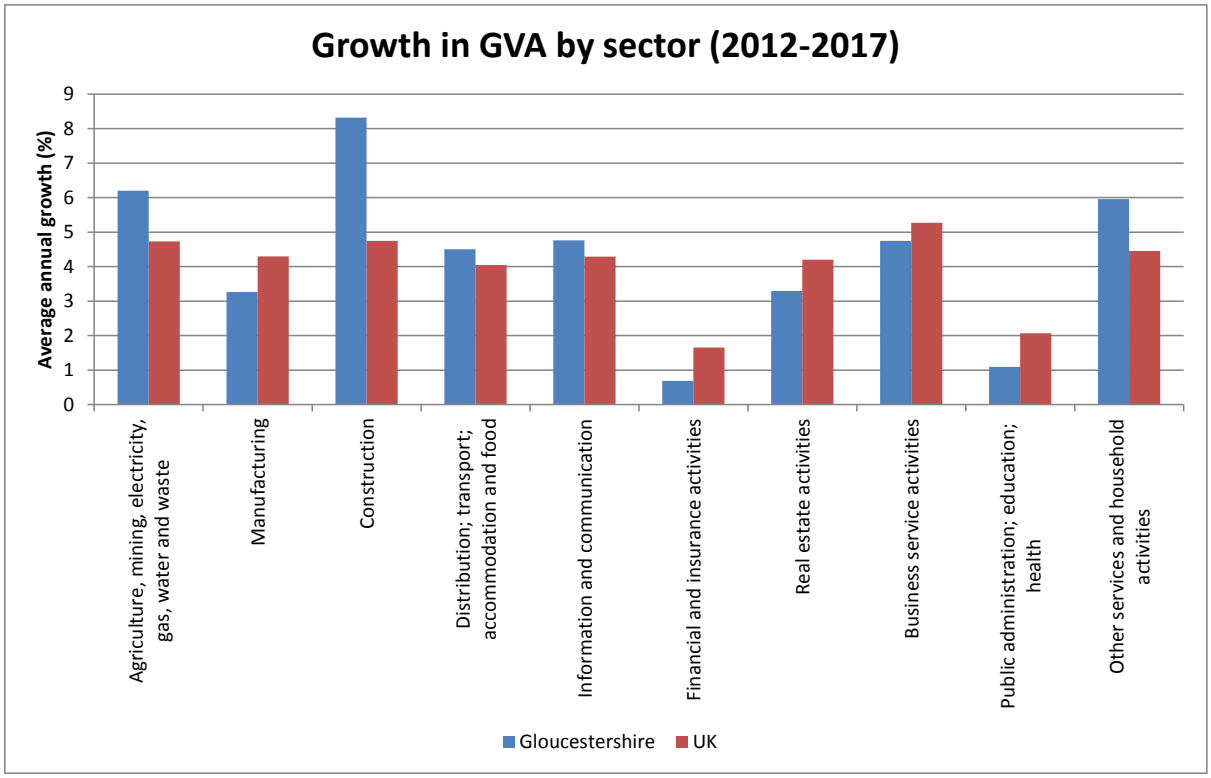


*Figure 18: Growth in GVA by sector, 2012-2017*[25]

The absence of productivity data below LEP level has meant that in the past we have been unable to identify geographical patterns in productivity across Gloucestershire, however estimates recently released by DEFRA suggests rural areas are playing a key role in driving Gloucestershire's productivity. Table 1 shows that productivity in Gloucestershire as measured in terms of GVA per Workforce Job is estimated to be at its highest in areas classed as Largely Rural, followed by those classed as Mainly Rural, conversely its is estimated to be at its lowest in those areas classed as Urban with Significant Rural. When compared to similar authorities Gloucestershire's rural areas have higher than average productivity, while its urban areas have slightly lower productivity.

*Table 1: Productivity in Gloucestershire by Rural Urban Classification, 2017*[26]

| Rural-Urban Classification (RUC) | GVA per Workforce Job (£) | Productivity compared with similar authorities |
|---|---|---|
| Largely Rural | 66,768 | 147% |
| Mainly Rural | 47,211 | 114% |
| Urban with City and Town | 45,583 | 95% |
| Urban with Significant Rural | 39,458 | 82% |
| Total | 48,049 | 94% |

[25] Regional gross value added (income approach), ONS
[26] Gloucestershire LEP Rural Analysis, DEFRA

The estimates produced by DEFRA suggest that at district level Tewkesbury has the highest levels of productivity at £66,769 per workforce job followed by Gloucester, while Stroud and Cheltenham have the lowest levels of productivity. When compared to similar authorities Tewkesbury, Cotswold, Gloucester and the Forest of Dean all have higher than average levels of productivity, with Tewkesbury and Cotswold displaying the best performance. Cheltenham and Stroud both have lower productivity than similar authorities.

*Table 2: Productivity in Gloucestershire by District, 2017*[27]

| Local Authority | Rural-Urban Classification | GVA per Workforce Job (£) | Productivity compared with similar authorities |
|---|---|---|---|
| Cheltenham | Urban with City and Town | 39,151 | 82% |
| Cotswold | Mainly Rural | 48,195 | 116% |
| Forest of Dean | Mainly Rural | 45,634 | 110% |
| Gloucester | Urban with City and Town | 52,661 | 110% |
| Stroud | Urban with Significant Rural | 39,458 | 82% |
| Tewkesbury | Largely Rural | 66,768 | 147% |

## The relationship between productivity and the "Five Foundations"

As mentioned previously the explanation behind the UK's productivity puzzle is unclear, what is clear is that productivity is complex, it is influenced by and influences a number of different issues. This section will look at how several different variables related to the 'Five Foundations' correlate to levels of productivity in Gloucestershire and other Local Enterprise Partnerships. It is important to note that this analysis will identify correlation not causation, this means it will tell us whether or not a relationship between a variable and productivity exists, but not that one causes the other.

Overall the strongest relationships found were between productivity and the proportion of residents employed in the knowledge economy and the proportion of working age residents with NVQ Level 4+. The following section will look at each foundation and each variable in detail.

### Business Environment

When exploring the relationship between productivity and the business environment the following variables were looked at:

- Business start-up rate
- Business survival rate
- Incidence of high growth firms
- Job density
- Employment in the knowledge economy
- Employment in high and medium technology

The variables with the strongest positive correlation with productivity were employment in the knowledge economy, followed by the incidence of high growth firms and business start up rates. Weak relationships were observed between business survival rates and employment in high and medium technology, suggesting these factors which are strength of the county may have less of an impact on productivity than others.

[27] Ibid.

Figure 19 shows a strong correlation between GVA per hour worked and business start-up rate, as the business start-up rate rises so too does GVA per hour worked. London has the highest business start up rate and GVA per hour worked, Gloucestershire in is the bottom half of LEP's in terms of business start up rate, suggesting it is under performing in this area. The apparent relationship between productivity and the business start-up rate suggests improving Gloucestershire's performance in this area might be something to focus on in the future.

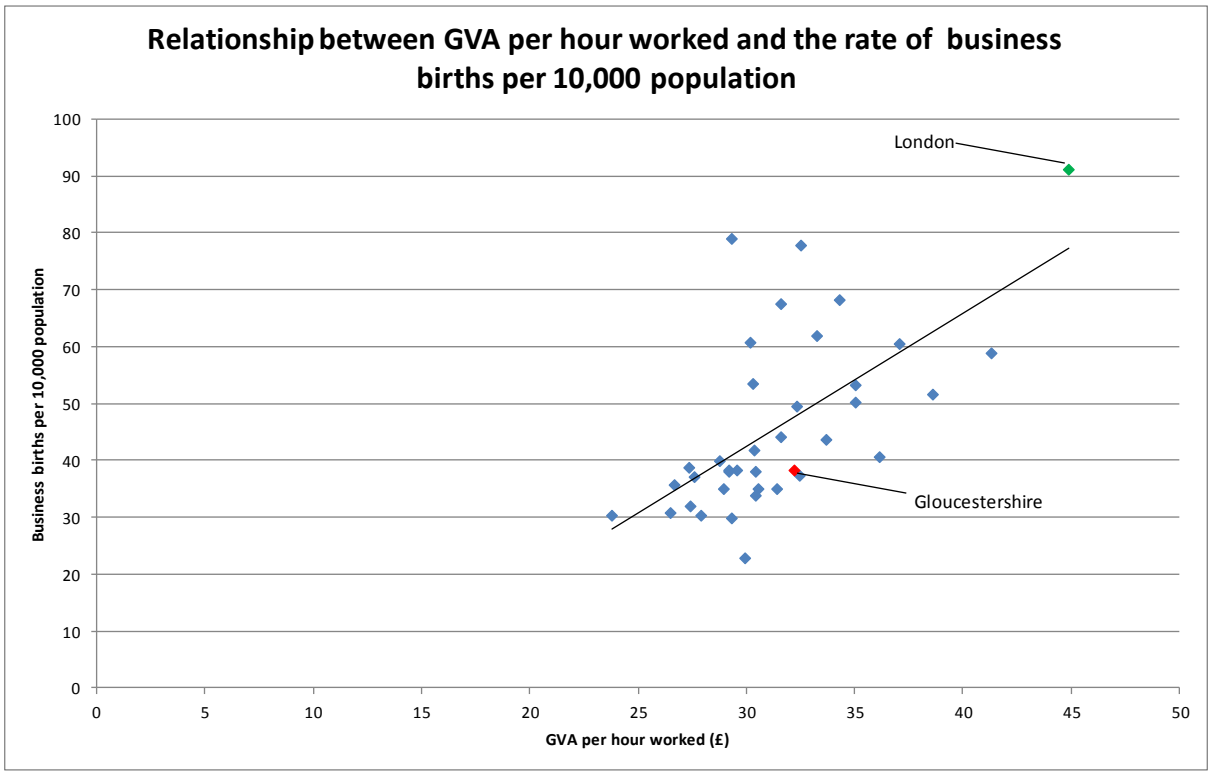


*Figure 19: Relationship between GVA per hour worked (2017) and Number of UK-owned firm births per 10,000 population 2017*[28]

Figure 20 shows there is very weak correlation between business survival rates and GVA per hour worked, with London having the highest productivity but the lowest business survival rate. Gloucestershire has the highest business survival rate of all LEP's and while this is generally seen as a strength of Gloucestershire, the correlation suggests it may not be a significant factor in driving the productivity of the area.

[28] Subregional productivity, ONS and UK Local Growth Dashboard 2019, Enterprise Research Council


*Figure 20: Relationship between GVA per hour worked (2017) and 3 year survival rates of businesses born in 2014 and surviving until 2017*[29]

Figure 21 looks at the relationship between GVA per hour worked and the incidence of high growth firms, with high-growth firms defined as those with an annualised average growth in employment of 20% or more over a three-year period and restricted to a business having at least 10 employees in 2014. It shows there is a strong relationship between these two variables, as the incidence of high growth firms increases so too does productivity. London has the highest incidence of high growth firms and the highest rate of productivity, while Gloucestershire is in the top half of all LEP's for both measures.

[29] *Ibid.*

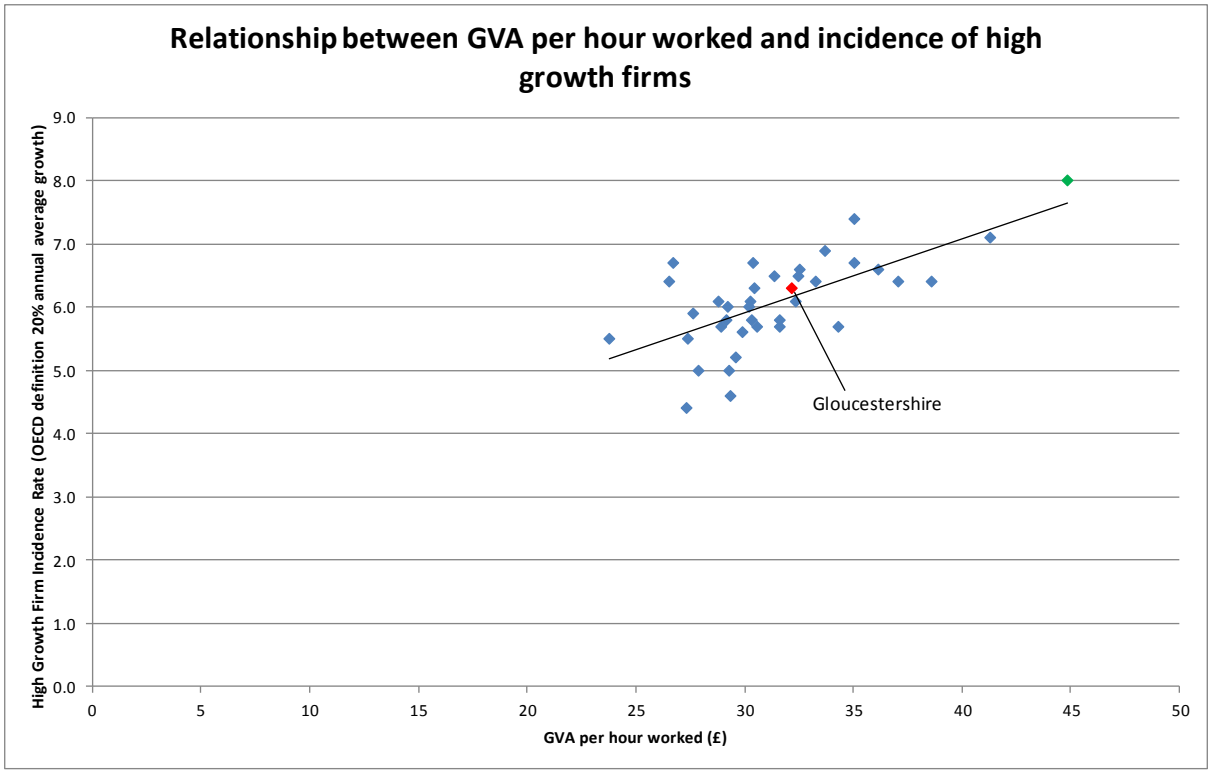


*Figure 21: Relationship between GVA per hour worked (2017) and the incidence of high growth firms (2014/2017)*[30]

Figure 22 shows a moderate correlation between GVA per hour worked and job density, as job density rises so too does GVA per hour worked. London has the highest job density and GVA per hour worked, Gloucestershire in is the top half of LEP's for both measures.

[30] *Ibid.*

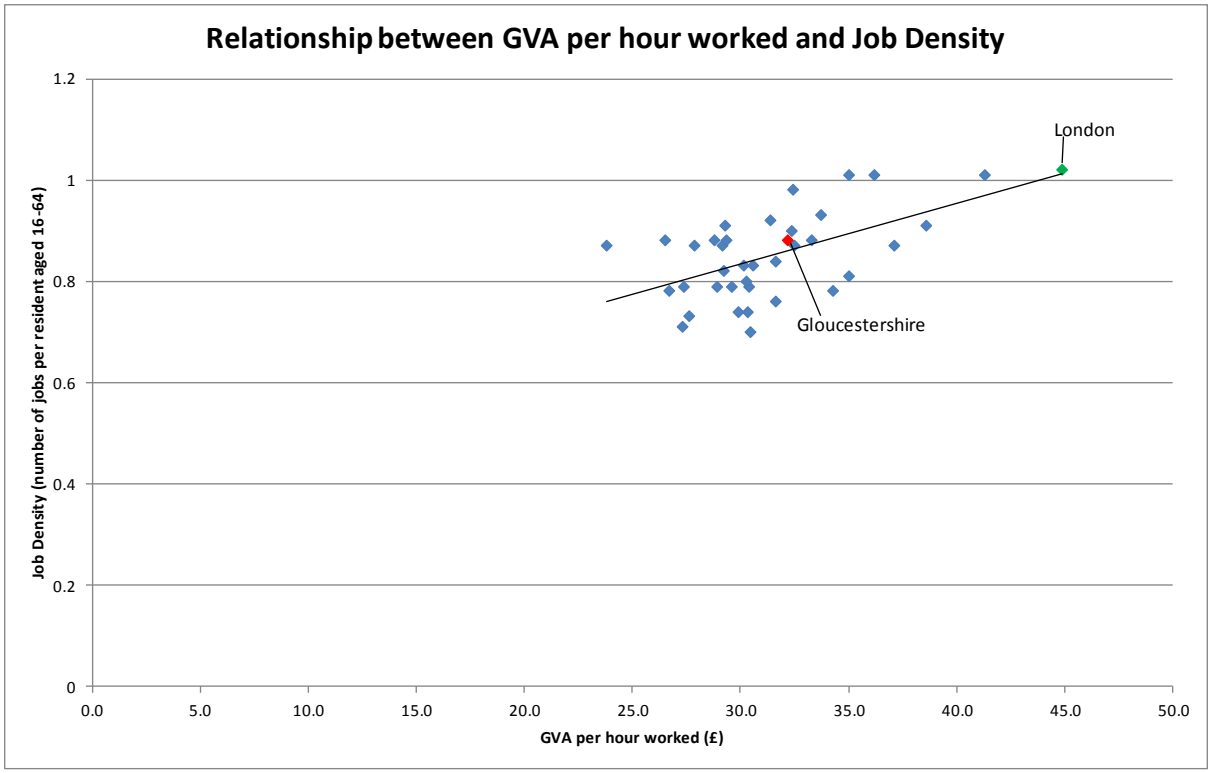


*Figure 22: Relationship between GVA per hour worked (2017) and Job Density (2017)*[31]

Figure 23 shows there is a very strong relationship between GVA per hour worked and employment in the knowledge economy, as employment in the knowledge economy increases so too does GVA per hour worked. London has the highest level of employment in the knowledge economy and GVA per hour worked, Gloucestershire in is the top half of LEP's for both measures.

[31] Subregional productivity, ONS and Job Density, ONS

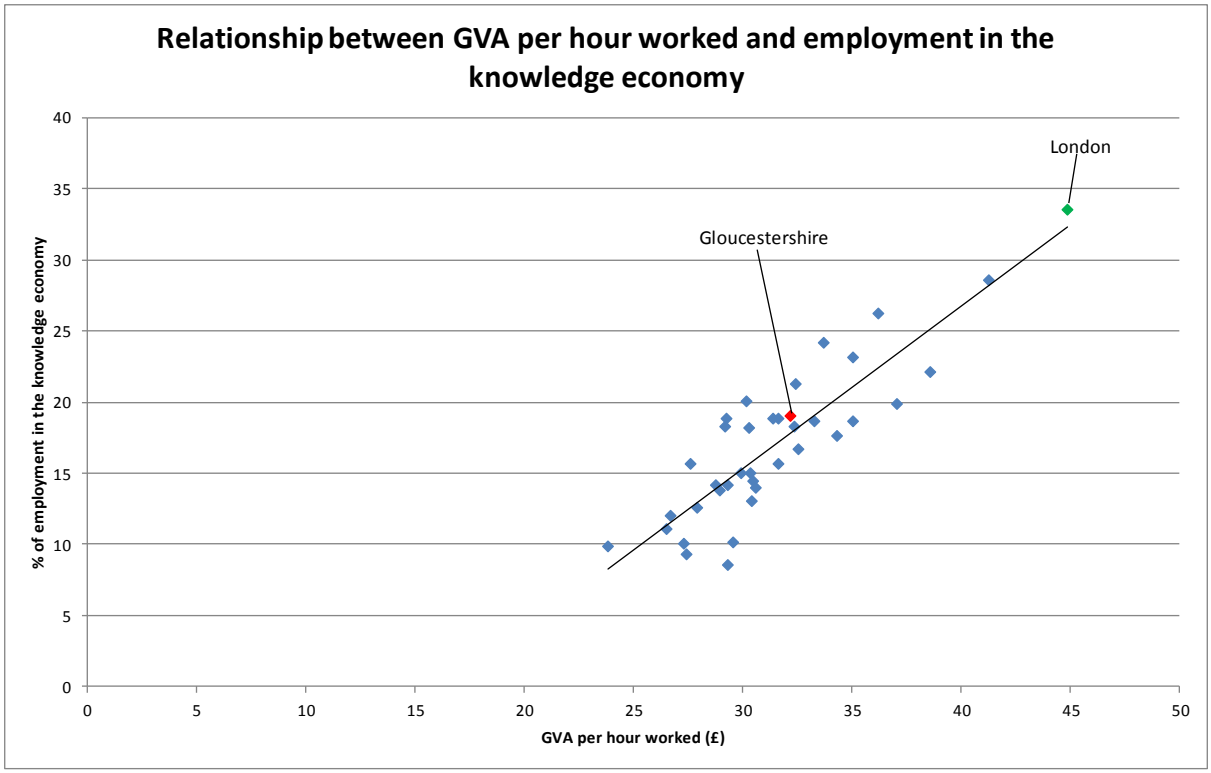


*Figure 23: Relationship between GVA per hour worked (2017) and employment in the knowledge economy (2017)*[32]

The relationship between GVA per hour worked and employment in high and medium technology is very different from that of knowledge economy. Figure 24 shows the relationship between the two variables is weak and is a negative relationship, meaning that as GVA per hour worked increases employment in high and medium technology falls. As the relationship is weak, employment in high and medium technology is less likely to have an influence on productivity than some of those factors discussed previously, where the relationship is stronger. Interestingly Gloucestershire has one of the highest levels of employment in high and medium technology and while this is an asset to the county the correlation suggests it may not be a significant factor in driving the productivity of the area.

[32] Subregional productivity, ONS and Business Register and Employment Survey, ONS

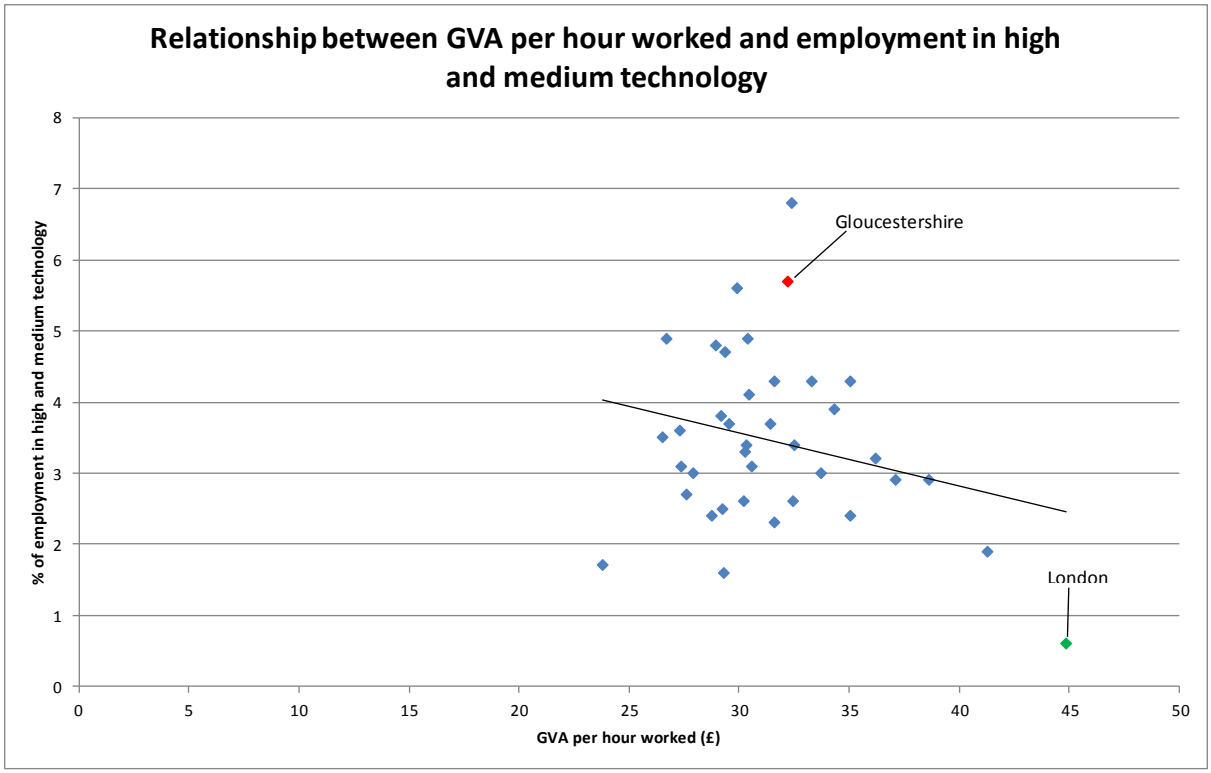


*Figure 24: Relationship between GVA per hour worked and employment in high and medium technology*[33]

## Ideas

When exploring the relationship between productivity and ideas the following variable was looked at:

- Business enterprise spend on R&D (BERD) per full time equivalent

Figure 25 shows there is a moderately strong relationship between business enterprise spend on R&D per full time equivalent and GVA per hour worked. This means that while there is some relationship between the two factors it is not as strong as some of those featured under business environment. One reason the relationship is weaker than others is that London which has the highest productivity has a relatively low business enterprise spend on R&D per full time equivalent, if London is excluded from the analysis the relationship increases to a strong relationship. This suggests business enterprise spend on R&D per full time equivalent may have a greater role in driving prosperity in areas outside of London. Gloucestershire in is the top half of LEP's for both business enterprise spend on R&D per full time equivalent and productivity.

[33] *Ibid.*

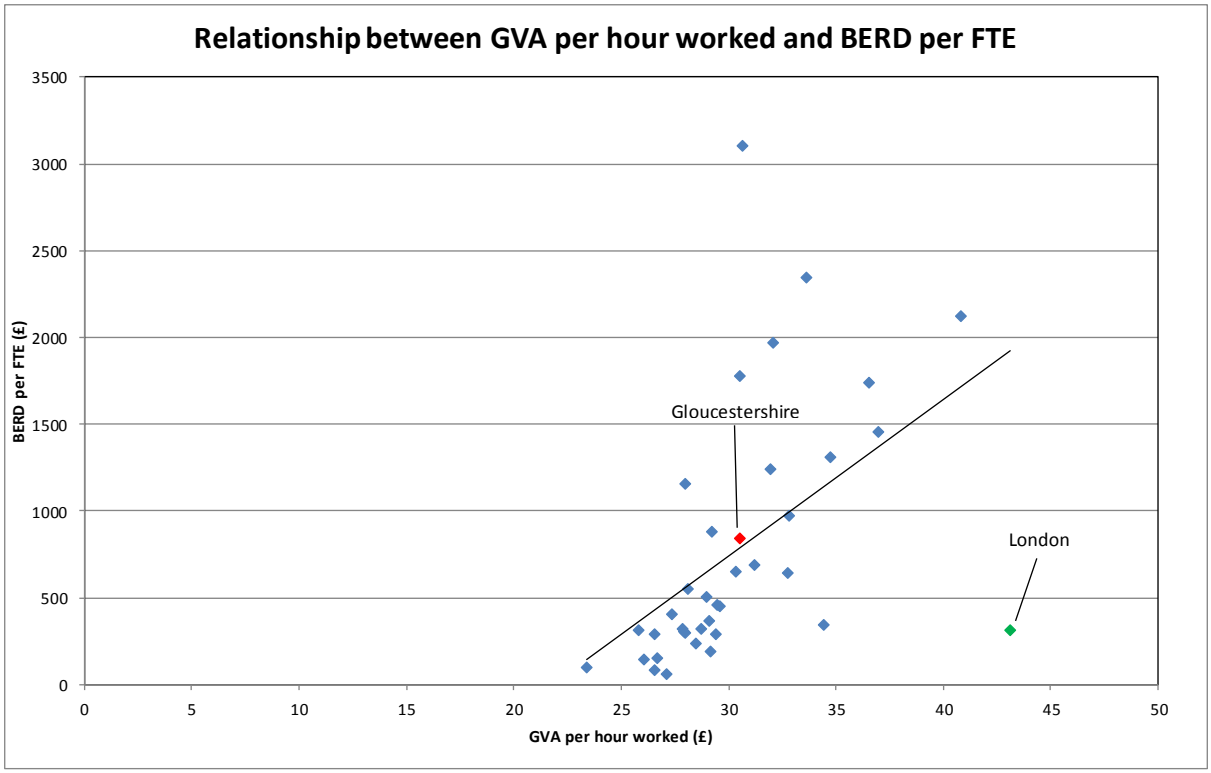


*Figure 25: Relationship between GVA per hour worked (2015) and Business Enterprise spend on R&D per full time equivalent*[34]

## Infrastructure

When exploring the relationship between productivity and infrastructure the following variables were looked at:

- Superfast broadband availability
- Average travel time to work

Figure 26 shows there is a weak relationship between GVA per hour worked and the availability of superfast broadband, those areas with the greatest availability of superfast broadband do not correspond with those with the highest levels of productivity. London the area with the highest productivity is ranked 13th in terms of availability of superfast broadband, Gloucestershire is in the top half of LEP's in terms of productivity but the bottom half in terms of availability of superfast broadband.

[34] Subregional productivity, ONS and BERD, ONS sourced via LEP Framework Dataset, Smart Specialisation Hub

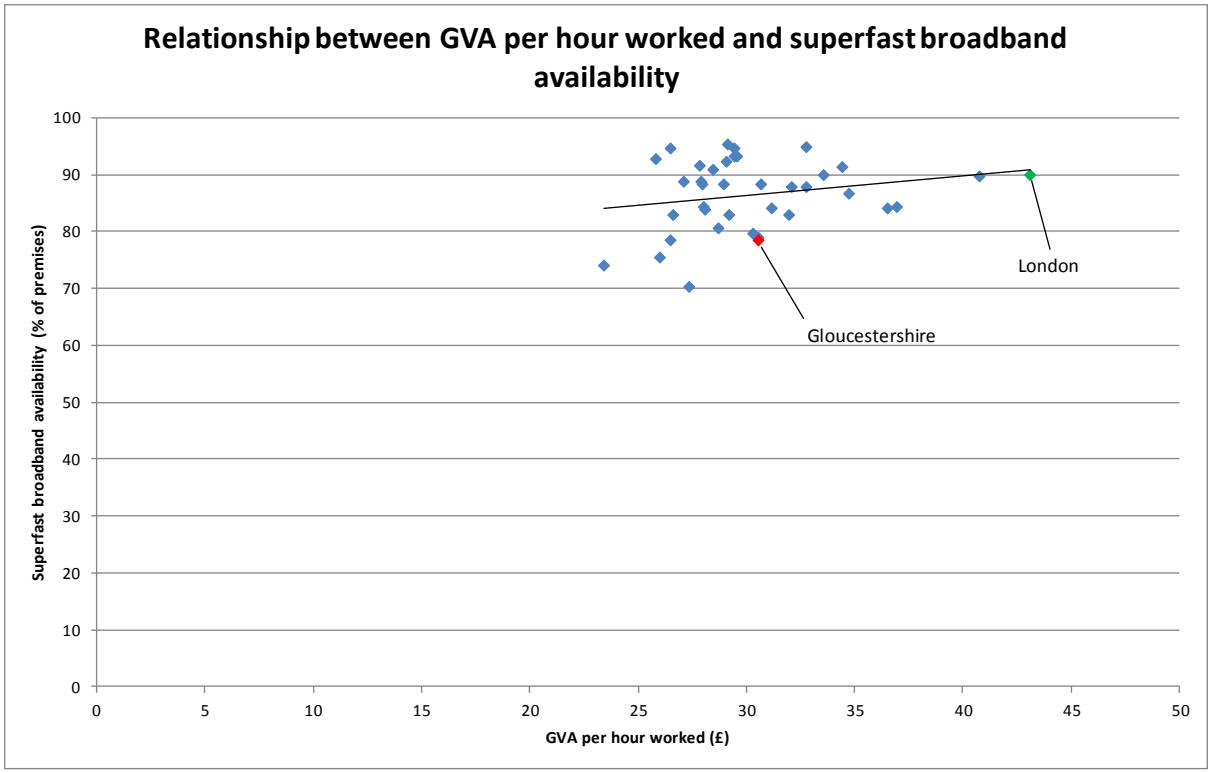


*Figure 26: Relationship between GVA per hour worked (2016) and superfast broadband availability (2016)*[35]

Figure 27 shows there is a strong relationship between GVA per hour worked and average travel to work time, as travel to work time increases so too does GVA per hour worked. It is likely that this is not a case of cause and effect but instead a result of other contributing factors, for example the nature of employment in an area might increase GVA per hour worked and also mean workers are more likely to travel further to work. London has the highest GVA per hour worked and the highest travel to work time, Gloucestershire sits in the top half for both measures.

[35] Subregional productivity, ONS and Ofcom sourced via LEP Framework Dataset, Smart Specialisation Hub

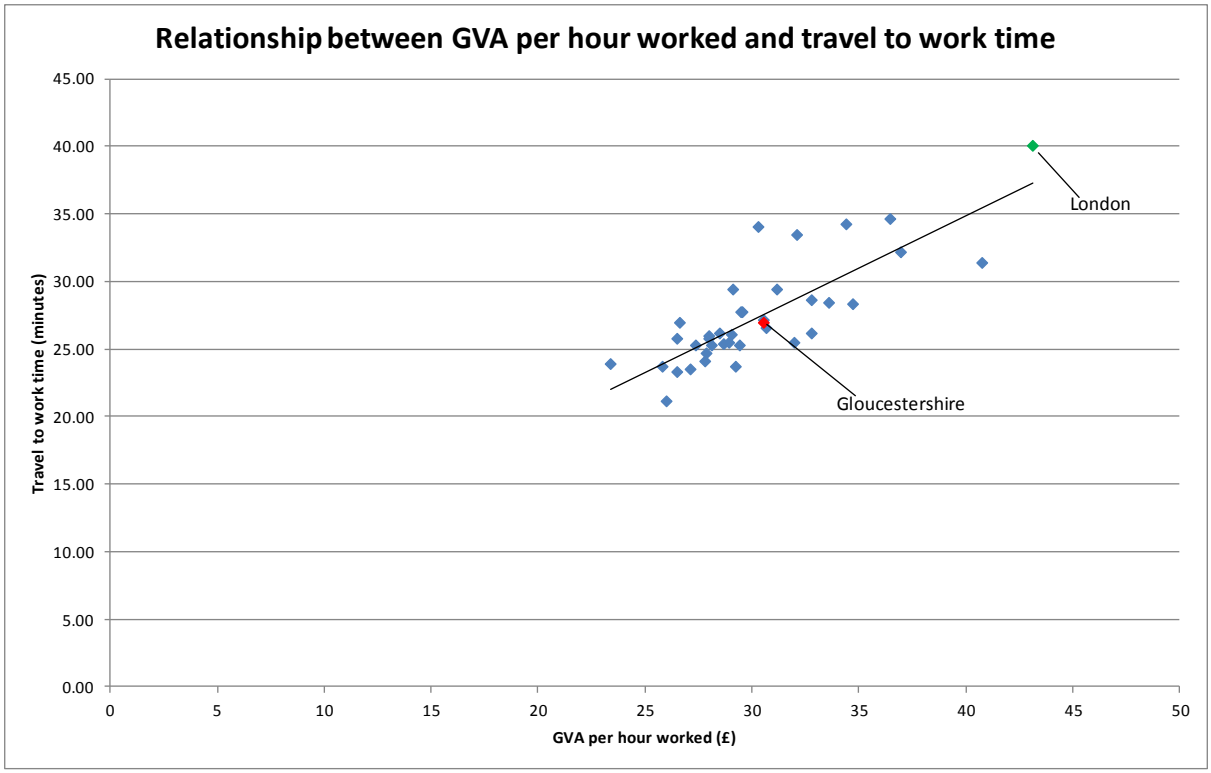


*Figure 27: Relationship between GVA per hour worked (2016) and average travel to work time (2016)*[36]

## People

When exploring the relationship between productivity and people the following variables were looked at:

- Residents with a long-term limiting illness
- Working age residents qualified to NVQ Level4+

Figure 28 shows a strong negative correlation between the proportion of residents with a long-term limiting illness and GVA per hour worked, as the proportion of residents with a long-term limiting illness decreases, GVA per hour worked increases. Although this relationship is likely to be complicated and influenced by a number of factors it does illustrate the importance of health and wellbeing for the local economy. London has the highest GVA per hour worked and one of the lowest proportion of residents with a long-term limiting illness, Gloucestershire sits in the top half of LEP's for productivity and the bottom half in terms of residents with a long term limiting illness.

[36] Subregional productivity, ONS and Labour Force Survey, ONS sourced via LEP Framework Dataset, Smart Specialisation Hub

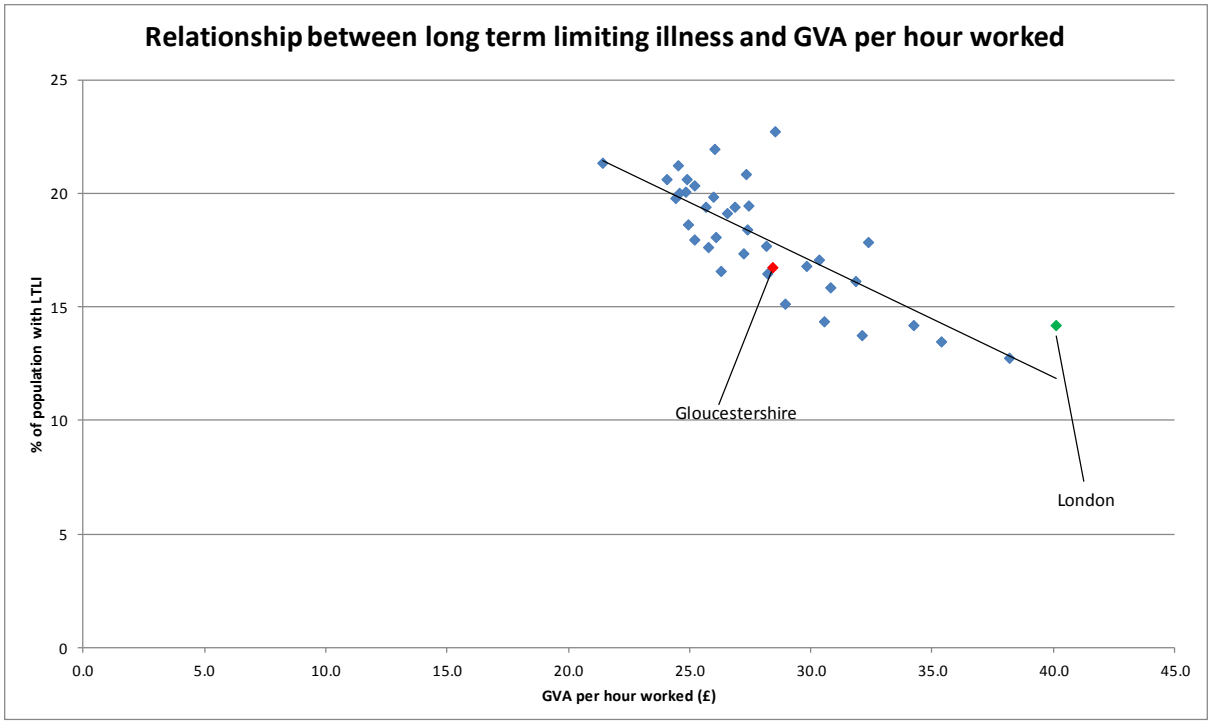


*Figure 28: Relationship between long term limiting illness (2011) and GVA per hour worked (2011)*[37]

Figure 29 shows there is a very strong relationship between GVA per hour worked and the proportion of residents with NVQ Level 4+, as the proportion of working age residents with NVQ Level 4+ increases so too does GVA per hour worked. It is likely this is not a simple case of cause and effect, but instead because having a high proportion of skilled workers influences the types of employment in an area which then drives productivity. London has the highest GVA per hour worked and the highest proportion of working age residents with NVQ Level 4+, Gloucestershire sits in the top half for both measures.

[37] Subregional productivity, ONS and 2011 Census, ONS

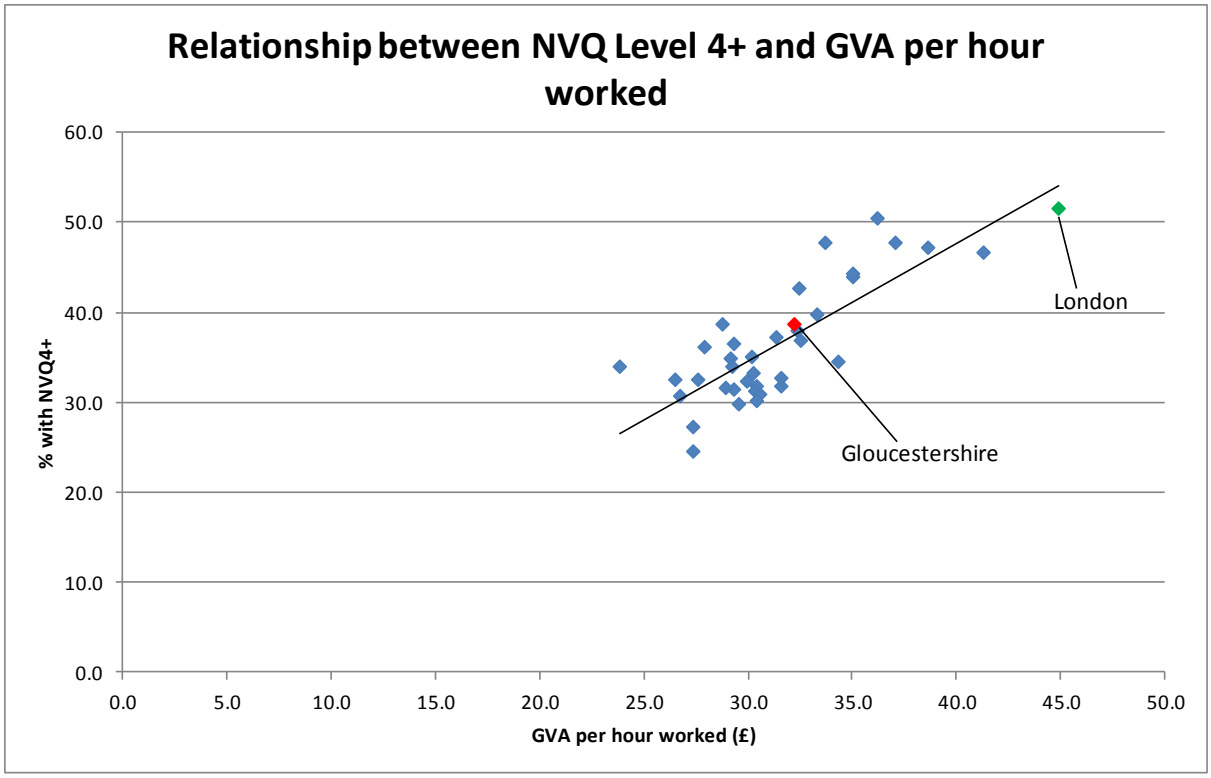


*Figure 29: Relationship between GVA per hour worked (2017) and the proportion of residents with NVQ Level 4+ (2017)*[38]

## Place

When exploring the relationship between productivity and place the following variable was looked at:

- Index of Multiple Deprivation Average Rank

Figure 30 shows there is a moderate negative relationship between deprivation and GVA per hour worked, there is some evidence that as deprivation decreases productivity increases but this relationship is a lot weaker than many others looked at previously. London has the highest level of GVA per hour worked but is in the top half of LEP's in terms of deprivation, Gloucestershire is in the top half of LEP in terms of productivity and the bottom half in terms of deprivation.

[38] Subregional productivity, ONS and Annual Population Survey, ONS

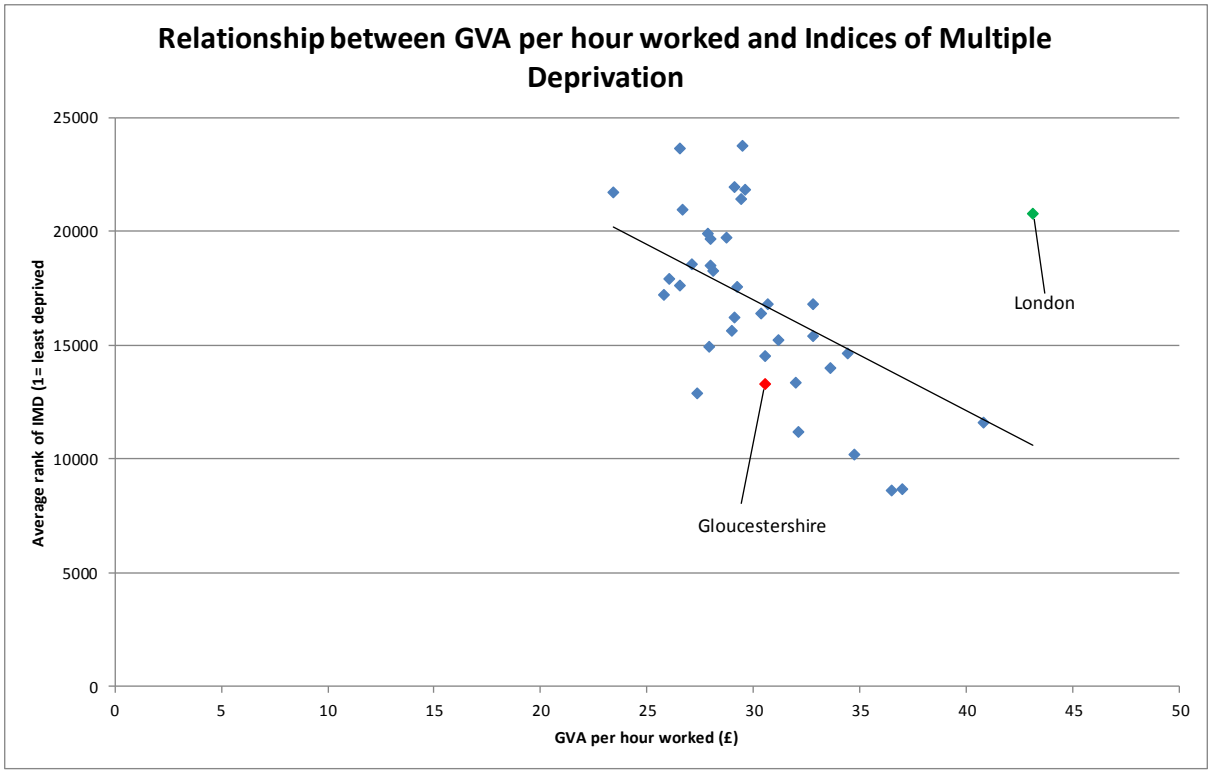


*Figure 30: Relationship between GVA per hour worked (2015) and Indices of Multiple Deprivation (2015)*[39]

[39] Subregional productivity, ONS and Indices of Multiple Deprivation, DCLG