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South East of England labour market projections 2017

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Contents

Executive summary

This report presents employment projections for the South East of England[1] by sector to 2041. These are trend projections and estimate jobs in future years based on the historic productivity relationship between output and jobs, and assumed future output growth.

This is the first time that GLA has produced projections for the South East of England, and so the results are **experimental**[2]. GLA Economics presented these projections, and projections for the East of England, to the Wider South East Officer Working Group[3] on 5 September 2017. The representative bodies for the East of England, the East of England Local Government Association[4] (EELGA), and the South East of England, South East England Councils[5], attend this meeting. At the request of the EELGA Cambridge Econometrics has conducted a comparison with its modelling for the East of England forecasting model[6] (EEFM), and the GLA modelling both in terms of methodology and results.

The central projections estimate that employment in the South East will grow at an annual average rate of 0.98 per cent, equivalent to 54,000 jobs per annum, to reach 6.194 million in 2041. Jobs in the Professional, real estate, scientific and technical sector are expected to grow strongly, accounting for over a third of the total increase expected in the South East of England to 2041. Strong employment growth is also expected in the Information and communication technologies, Education and Health sectors – collectively accounting for nearly 75% of the expected total South East of England increase to 2041.

The central projections in this paper use the 2016 employment data point as the starting point from which to project. There has been strong growth in employment in the past few years – much stronger than would have been expected given output growth (the so-called 'productivity puzzle'). As more analysis is published on this conundrum and as the outlook for the UK economy continues to be unclear it is possible that there may be a new trend in output growth (compared to the historic trend used to derive the productivity relationship on which the projections are based) – the potential consequences are explored further in this paper.

The analysis underpinning these projections was originally completed alongside that for the 2017 London Labour Market Projections in Spring 2017, and used the information available at the time. Subsequently the Office for National Statistics (ONS) has published workforce jobs data for 2017, and the Office for Budget Responsibility (OBR) revised downwards its assumptions for UK output and productivity growth. This information has not been incorporated in the modelling in this paper for consistency with the published London projections.

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[1] The definition used is Government Office Region

[2] ONS describes experimental statistics as in the testing phase, and not yet fully developed, see Guide to Experimental Statistics – Office for National Statistics

[3] This is part of the governance structure to support the Wider South East Summit of the Mayor of London, London Councils, the East of England Local Government Association, and South East England Councils. The purpose of the Summit is to promote Policy and infrastructure collaboration across the Wider South East | London City Hall

[4] This is a politically-led, cross party organisation which works on behalf of 52 local councils in the East of England, see EELGA

[5] South East England Councils promotes the views and interests of local government in the South East of England. GLA extended an offer to this group to comment on, and contribute, to a review of GLA projections for the East and South East of England.

[6] See Cambridgeshire Insight – East of England Forecasting Model (EEFM). This produces forecasts for the East and South East of England.

The projections rely heavily on historic data. As a matter of course the GLA uses ONS data, where available. This is available for jobs from 1996, and for output, as measured by Gross Value Added (GVA), from 1997. To support judgements about future trends the GLA has developed its own back series of data to 1981 for jobs and GVA.

Introduction

This report presents GLA Economics' projections of employment (jobs) in the South East of England, and disaggregated by sector.

The South East of England and sector projections are trend projections and estimate jobs in future years based on the historic productivity relationship between output and jobs, and assumed future output growth.

This report begins with a brief overview of the methodology used and a discussion of a review by Cambridge Econometrics. It then presents the results for the South East of England as a whole and is followed by some sensitivity analysis. The results by sector follow this.

South East of England region

The standard current definition for the South East of England is the Government Office Region (GOR). There is also a GOR for the East of England. London is another such region. The regional offices were established in 1998, although they no longer exist.

The geography associated with the GOR continues as the main spatial definition for the area, and is used in ONS publications. Prior to the establishment of GORs the ONS used Standard Statistical Regions (SSRs) as its main spatial definition for analysis.

There were two SSRs for the WSE:

- East Anglia
- Rest of South East

The geography for these two SSRs maps exactly onto the geography for the GORs of the East of England and South East of England.

The East of England consists of:
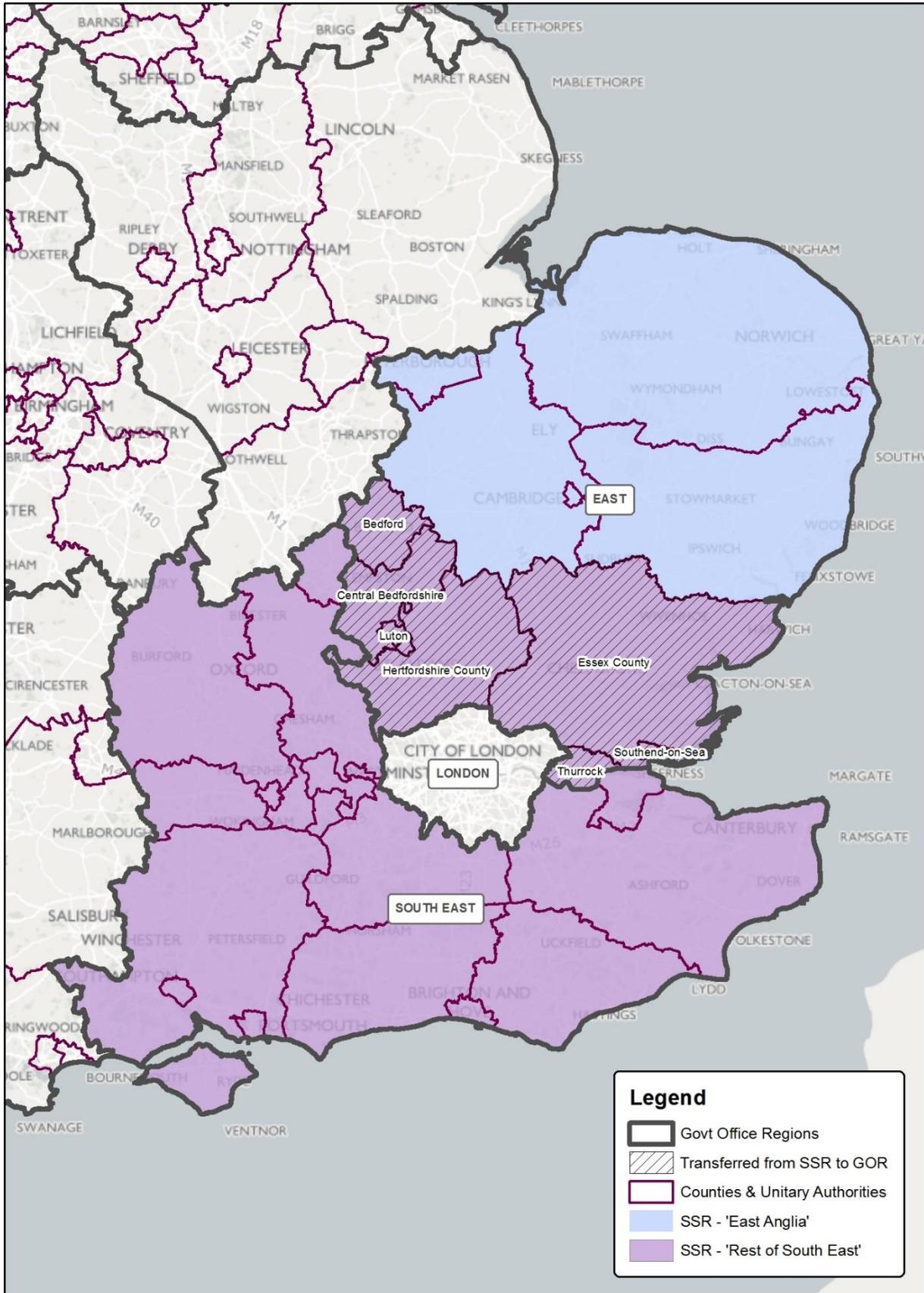
- East Anglia
- Bedfordshire and Hertfordshire
- Essex

The South East of England is the same as the Rest of South East SSR less:

- Bedfordshire and Hertfordshire
- Essex

The geographies, and relationship to London, are at Map 1.

Map 1 Alignment of Government Office Regions and Government Statistical Regions in the Wider South East of England

Source: GLA Intelligence Unit

Methodology

The medium-term trend-based projections in this paper use the same methodology as the London projections[7] (the rationale for this methodology and further details can be found in *Box 1: Should the employment projections 'jump off' from the 2016 level of employment* and *Appendix A: Methodology for GLA Economics' trend-based medium-term projections*). The South East of England and sector projections are, again, based on the employee and self-employed components of ONS Workforce Jobs series[8]. The South East of England individual sector projections are constrained to the total for the South East of England employment projections.

All medium-term trend-based projections are constructed by using the latest data point from which to project. Previous papers have highlighted a potential issue with this approach[9] and this issue is explored again in this paper given the continuation of recent productivity trends (what has come to be known as the 'productivity puzzle').

These projections, and the corresponding projections for the East of England, have been produced in the spirit of cooperation. They are to provide a shared understanding of the technical evidence to inform plan-making across the Wider South East.

GLA Economics presented these projections, and projections for the East of England, to the Wider South East Officer Working Group[10] on 5 September 2017. The representative bodies for the East of England, the East of England Local Government Association[11] (EELGA), and the South East of England, South East England Councils[12], attend this meeting. At the request of the EELGA Cambridge Econometrics has conducted a review. This provided a comparison with its modelling for the East of England forecasting model[13] (EEFM), and the GLA modelling both in terms of methodology and results. GLA Economics welcomed this request as its expertise is principally in the London economy, and it has conducted less analysis of the Wider South East[14].

There are similarities between the approach adopted by GLA and CE to estimate future jobs numbers namely that both models look forward on the basis of productivity and GVA assumptions. CE had a number of comments on the GLA Economics approach:

- *GLA Economics estimates jobs at the level of the region, and constrains sector estimates to regional jobs totals.* An alternative would be to project sector jobs at a national level,

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[7] At London labour market projections 2017 | London City Hall and on London Datastore
[8] Annual averages, excluding sectors T (activities of households as employers; undifferentiated goods and services producing activities of households for own use) and U (activities of extraterritorial organisations and bodies).
[9] See, for example, GLA Economics 'Working Paper 38: Employment projections for London by sector and trend-based projections by borough', p.6.
[10] This is part of the governance structure to support the Wider South East Summit of the Mayor of London, London Councils, the East of England Local Government Association, and South East England Councils. The purpose of the Summit is to promote Policy and infrastructure collaboration across the Wider South East | London City Hall
[11] This is a politically-led, cross party organisation which works on behalf of 52 local councils in the East of England, see EELGA
[12] South East England Councils promotes the views and interests of local government in the South East of England. GLA extended an offer to this group to comment on, and contribute, to a review of GLA projections for the East and South East of England.
[13] See Cambridgeshire Insight – East of England Forecasting Model (EEFM). This produces forecasts for the East and South East of England.

[14] See, for example, Chapter 2 of Economic Evidence Base for London 2016 | London City Hall for some analysis it has conducted.

and allocate across regions. A feature of jobs growth in the London economy has been the clustering of jobs in central areas, and how this allows agglomeration economies to be reaped[15]. This provides a justification for London regional level projections. It is less clear how defining a feature this is of jobs growth in the South East of England economy.

- *A corollary is that there is not a sense check between GLA Economics jobs projections, and those for the national economy.* Now that GLA Economics has produced projections for the East[16] and South East of England, as well as London, the overall share of UK jobs covered by these projections is close to half. GLA Economics does not at the present time have UK-level jobs projections.
- *Another sense check would be against labour supply derived from population projections.* In its London labour market projections GLA Economics provides an alternative jobs projection based on a constant employment rate applied to the GLA working age population projection. This document has a similar analysis, and has an additional sense check of a comparison of on trend jobs projections[17].

CE argued that the GVA growth rate assumption for the South East of England was too low. GLA Economics tested these changes, and the UK GVA growth rate assumption used by CE in its model. The two sets of changes were offsetting and left the GLA Economics jobs projections largely unchanged. It should also be noted that differences in methodology can lead as well to differences in outcomes for sector projections.

CE also noted that a consequence of GLA Economics assumptions is that the estimated growth rate for jobs in the East and South East is higher than for London. By construction it is inevitable that the GLA will estimate a slowing down of jobs growth in London when it assumes a slowing down in GVA growth but no corresponding change in productivity growth.

EELGA has expressed interest in GLA projections because it provides additional evidence to the EEFM. GLA Economics has published comparative analysis of different forecasts for London[18], which shows that there can be a range of outcomes across well respected forecasts. This recognises that there is always uncertainty around how an economy might evolve. GLA Economics provides these projections in this spirit, and it should be noted that they are **experimental**[19]. GLA Economics will keep its methodology under review.

The main projections are to 2041, while projections published on London Datastore are to 2050[20]. South East of England total and sector projections apply the same methodology for the period to 2050 as for the period to 2041.

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[15] See, for example, Chapter 2 of Economic Evidence Base for London 2016 | London City Hall
[16] See https://www.london.gov.uk/business-and-economy-publications/wider-south-east-labour-market-projections-2017
[17] The results are at Table 3 for a jumping off point of 2008, the last year estimated to be on trend for jobs growth
[18] See CIN 40: Performance of GLA Economics' employment projections | London City Hall
[19] ONS describes experimental statistics as in the testing phase, and not yet fully developed, see Guide to Experimental Statistics – Office for National Statistics
[20] See https://data.london.gov.uk/dataset/wider-south-east-long-term-labour-market-projections

Total South East of England employment projections

As mentioned above, the projections rely on historic productivity (output divided by employment). Figure 1 shows the logged ratio of employment to output (the inverse of productivity) for South East of England-wide employment underlying both the current and previous projections. The chart also includes a fitted local regression curve to highlight the historic trend. As a log, the negative gradient is equal to the output growth that would be required to maintain stable employment i.e. a gradient of -1.0 suggests that an annual output growth of 1.0 per cent would maintain zero employment growth[21]. So, in the case of the South East of England output growth of 1.70% a year would maintain zero employment growth.

Figure 1: Log of total employment as a proportion of total output growth in the South East of England – current estimate (1981-2016)
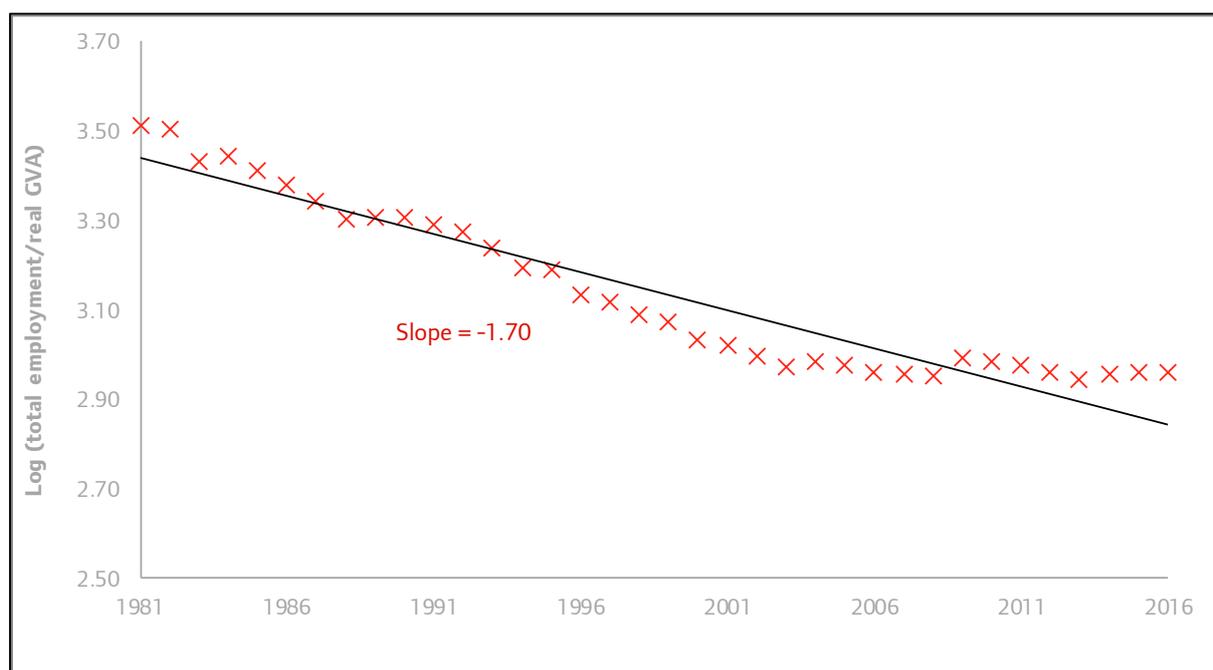
Source: GLA Economics

Figure 1 shows that, in most years, productivity is close to trend (where trend is represented by the fitted regression line) with it moving closely around trend depending on the economic cycle.

Recently, however, productivity growth has continued to diverge from trend. This has been puzzling many respected organisations and economists and its implication for the projections in this paper is explored further in Box 1.

In order to generate long-run employment projections for the South East of England GLA Economics combines an output growth assumption with a projected productivity trend (the latter of which is based on the observed historic productivity trend).

To put this into context, the latest Office for Budget Responsibility (OBR) at the time of completion of these projections revised downwards the GDP growth forecast for the rest of the

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[21] The log of employment growth is the same as log (output growth/productivity growth). If both output growth and productivity growth are 1.0 then their ratio is 1, and log (employment growth) = log (1) = 0. From which it can be concluded that employment is stable.

decade to an average of 2.1 per cent a year, and 2.0 per cent in 2021. GLA Economics is assuming average South East of England GVA growth of around 2.0 per cent a year to 2041.

The productivity trend used for the medium-term employment projection to 2018 is the trend for the South East of England from 1981 to 2016, and the trend used for later years of the projection is also the trend from 1981 to 2016.

The results of the projection are presented in Figure 2. The projections estimate that employment in the South East of England will grow by an annual average rate of 0.98 per cent, equivalent to 54,000 jobs per annum, to reach 6.194 million in 2041. For completeness and comparison, the Figure includes low and high jobs scenarios – definitions and results are available below in the section on sensitivity testing.

Figure 2: Historic and projected employment by scenario in the South East of England (thousands), 1981-2041
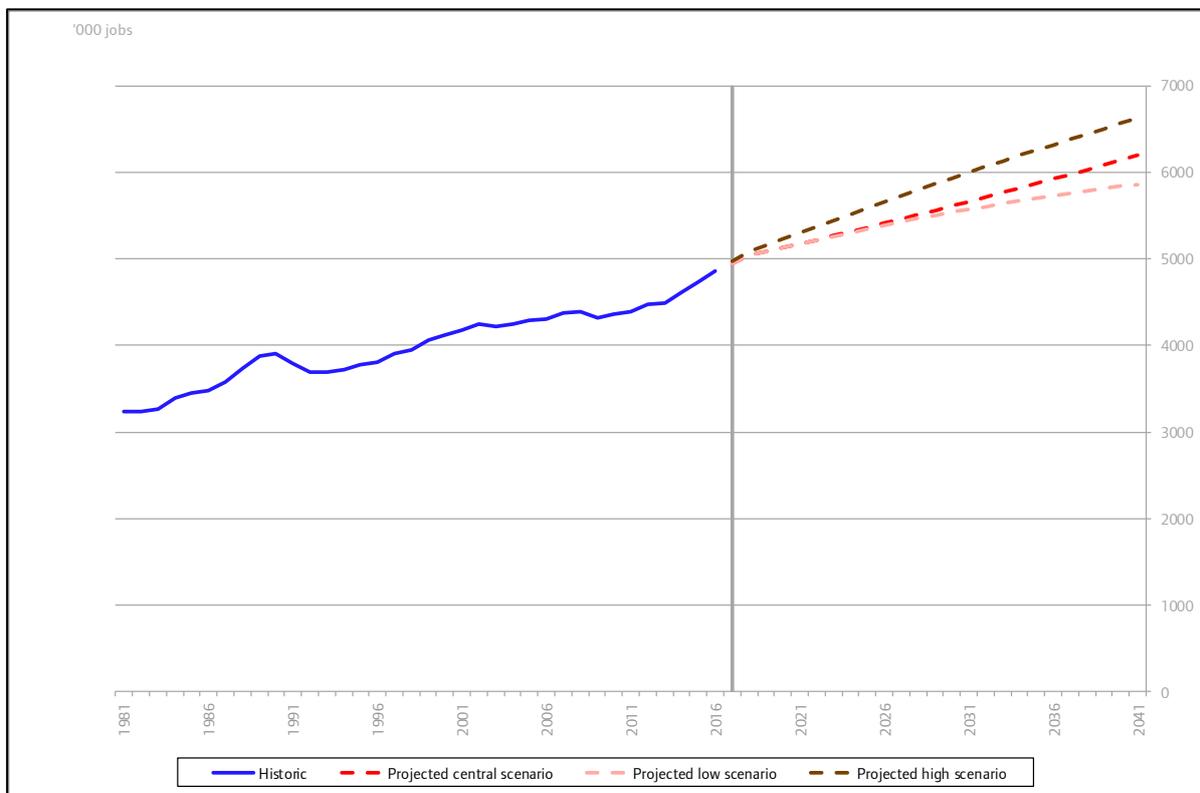
Source: GLA Economics

Box 1: Should the employment projections 'jump-off' from the 2016 level of employment?

The trend methodology used to construct the projections in this paper is based on the premise that a variable's history includes the effects of everything that has driven it. In other words, to get to its current level, employment has been impacted by economic growth, population, migration, changes in sectoral growth, technology, working practices and so on. The relationship between all these drivers and employment is implicit in the historic employment data.

Although, as many other forecasters do, it is possible to look at each of these drivers individually to assess their impact and model them individually, there are likely to be so many drivers that attempting to model them would likely only partially explain the history. Moreover, to model the drivers requires an understanding of the drivers of those drivers that results in a myriad of variables each supposedly impacting on employment. For example, if international migration is thought to affect employment then it is necessary to consider what affects international migration (so things like conditions in the individuals' home country, relative output growth, cost of travel and so on). It is then necessary to be able to say how these factors are likely to change in 20 years, or so, time, such that the employment projections also depend heavily on these necessary underlying assumptions. This approach may be reasonable when considering what employment may be in the short-term. However, the further into the future one goes the greater the compound error is likely to be on the forecasts for the drivers of employment. The cumulative effect of this across all the drivers can then raise doubts as to the reliability of the future employment estimates that are dependent on them.

The trend-based methodology that GLA Economics adopts is arguably a more reasonable approach so long as (a) the variable is not random (in other words, it follows a relatively stable path) and, (b) future shocks or structural changes do not differ in magnitude to those in the past. Applying this to productivity (which is used as the basis for our projections given the mathematical relationship between employment and output whereby Δ in employment = Δ in output − Δ in productivity), as can be seen in Figure 1, productivity is not a random variable and has historically followed a trend. Regarding structural changes, this is ultimately a point of judgement. Whilst Figure 1 does not clearly suggest structural changes in the productivity trend for the South East of England, especially as there have been other periods both above and below trend, there have been questions as to whether more recently the trend in productivity is reflective of a new trend/structural change.

In the five years since 2011 alone, employment has grown by 10.6 per cent, which equates to an annual average growth rate of 2.0 per cent or 93,400 jobs per year. This contrasts starkly to a total growth of 35.6 per cent, or an annual average growth rate of 1.0 per cent or 38,400 jobs per year, over the 30-year history from 1981 to 2011. At the same time, however, in the five years since 2011 output in the South East of England has grown by an average annual rate of 2.3 per cent, which compares to the estimated 2.8 per cent per annum experienced between 1981 and 2011.

The impact of these relative changes in employment and productivity growth is, perhaps, particularly stark when looking at productivity over the long run and over a number of economic cycles (see Figure A). To support this comparison Figure A includes trendlines for South East of England and UK productivity growth for 1984-2011 (and extended to 2015).

Box 1 continued

Figure A: Productivity in the South East of England and the UK over the long-run
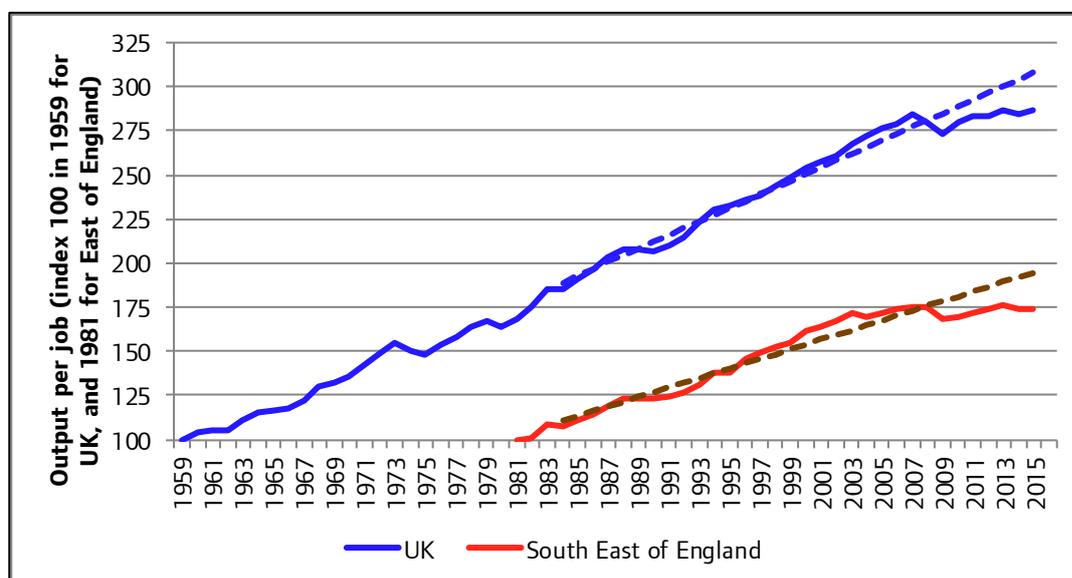
Source: ONS and GLA Economics

What is striking, particularly at a national level, is that productivity growth has remained at a low rate since the 2008 recession, and has not recovered to long-run trends. The length of this period of low productivity growth is the basis for the OBR making the judgement that productivity growth may take some time to recover to historic rates. GLA Economics has made a similar judgement in the construction of these employment projections.

The recent exceptional growth in employment raises the question of where the GLA Economics projections should start from – or the year from which they should 'jump off'. This is something that the projections have previously considered (see, for example, Working Paper 38 page 6) but has become an increasingly important issue with the recent productivity trend. So, the question of what the jumping-off point for the projections should be comes down to whether the 2016 level of employment is representative of an 'on-trend' point in the economic cycle, and if not, what year is?

To understand this better GLA Economics looked at a series of economic commentators to see when they estimated the economy to be on trend. The corresponding employment levels in these periods were then trended to produce a range of on-trend employment projections (see Appendix B for further details). In the balance of that work, 2008 appears to be the last year that the South East of England's employment was 'on-trend'. This can also be seen by looking at Figure B. The various solid lines show a range of potential on-trend employment levels through to 2041. The dotted red lines show how GLA Economics employment projections would sit within that range if they jump-off the on-trend 2008 estimate of employment (left hand) and if they jump-off the 2016 employment estimate (right hand).

Box 1 continued

Figure B: Performance of GLA Economics employment projections starting from different base years compared to a range of estimated on-trend projections
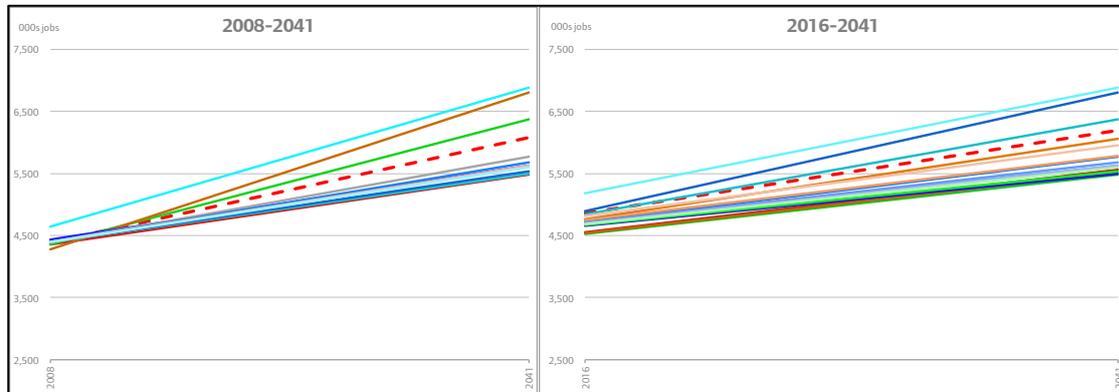
Source: GLA Economics

As Figure B shows, the projections which use the latest employment data point to jump off from are likely to start above the existing estimates of trend, and be at the upper end of the majority of other estimates in 2041 suggesting projected levels of employment in 2041 that may be on the high side in comparison to trend.

However, estimates of output gaps and trend points in the economy are notoriously difficult to estimate and the likely future long-run path of productivity remains unclear. This is an area that GLA Economics, alongside others, continue to monitor closely. Given productivity has previously diverted from the trend line (albeit perhaps not as much) (see Figure 1), that the projections assume a decline in long-term output potential, and the remaining uncertainty around developments in the economy, then the South East of England jobs projection does not look unreasonable. Nonetheless, as the situation evolves, GLA Economics will continue to monitor the situation and review their methodology.

Sensitivity testing

Given the recent employment performance (see Box 1) and future economic uncertainty, a number of alternative employment projection scenarios have been produced as a means of sensitivity testing the central scenario. These are based on alternative assumptions from the key underlying assumption in the 'central' projections presented in the previous chapter, and are summarised in Table 3[22]. For context, the table also includes summary information on the historic employment growth experienced in the South East of England (1990 and 2008 were years when employment was at a cyclical peak, and 1981, 1992 and 2009 were years when employment was at a cyclical trough), something which is key to put these alternative scenarios into a wider context.

Table 3: Summary results from alternative assumptions

	2041 employment level (millions)	Per annum employment growth (2016-2041 for projections)	
		average %	level
Historic 1981 to 2016	-	1.16	46,230
Historic 1981 to 2012	-	1.05	39,770
Historic 1990 to 2016	-	0.84	36,680
Historic 1990 to 2012	-	0.62	25,830
Historic 1992 to 2016	-	1.14	48,260
Historic 1992 to 2012	-	0.95	38,650
Historic 2008 to 2016	-	1.26	58,000
Historic 2008 to 2012	-	0.45	19,690
Historic 2009 to 2016	-	1.67	75,790
Historic 2009 to 2012	-	1.11	48,420
Central growth assumption (medium term 2.0% pa, remaining at 2.0% pa)			
Central scenario, 2016 jump-off	6.19	0.98	53,530
2008 jump-off	6.07	0.98	52,490
High growth assumption (medium term 2.5% pa, falling off to 2.0% pa)			
2016 jump-off	6.63	1.25	70,830
2008 jump-off	6.50	1.25	69,460
Low growth assumption (medium term 2.0% pa, falling off to 1.5% pa)			
2016 jump-off	5.86	0.76	40,270
2008 jump-off	5.75	0.76	39,490

Note: 2041 employment levels have been rounded to the nearest 10,000; percentages have been rounded to the nearest 2 decimal places, and the per annum projected growth in employment numbers to the nearest 10.

One of the fundamental assumptions underpinning the projections is regarding the long-run annual rate of output growth in the South East of England. Under the 'central' scenario GLA Economics assumes a medium-term growth rate of 2.0 per cent per annum over the period to 2018, and this remains at the rate of 2.0 per cent per annum over the longer term. As such, it assumes that the South East of England grows at a similar rate as the UK in the long run.

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[22] The figures for the jumping off point of the last on trend year of 2008 are lower than for the 2016 jumping off point because jobs in 2016 were above the estimated trend.

The London labour market projections 2017[23] also assumed convergence to a GDP rate of growth of 2.0 per cent per annum, in line with an extrapolation of the OBR medium-term projections from March 2017 into the long-term[24]. The OBR published in January 2018 a long-term projection that assumed a recovery of long-term GDP growth to 2.2 per cent per annum.

To test the sensitivity of the projections to the assumed output growth rate, the model has been re-run under different assumptions for the medium and long-term growth rates. In the high scenario, the medium-term assumption is a 2.5 per cent per annum GVA growth rate in the South East of England. This is consistent with what had previously been the OBR assumption for long-term output growth potential. The low scenario maintains in the medium term the growth rate assumption of the central scenario of 2.0 per cent to 2018. It assumes in the longer term a 1.5 per cent per annum GVA growth rate. This recognises the downside uncertainty in the future output potential for the UK and South East of England economies.

Under the high assumptions of medium-term output growth of 2.5 per cent per annum and long-term output growth of 2.0 per cent per annum, and with employment projected off from the 2016 level, employment grows at 1.25 per cent per annum – this is higher than the annual growth rate seen in employment for most years from 1981 onwards to 2016, but not for 2008 and 2009. By 2041, employment in this scenario is projected to reach 6.63 million – equivalent to an additional 70,830 jobs per annum. This level of employment in 2041 is 7.0 per cent higher than under the 'central' scenario.

Under the low assumptions (with medium-term growth of 2.0 per cent per annum and long-term output growth of 1.5 per cent per annum), and with employment projected off from the 2016 level, employment grows at 0.76 per cent per annum, equivalent to 40,270 jobs. By 2041 employment is estimated to reach 5.86 million under this scenario – 5.4 per cent lower than under the central scenario.

Another necessary assumption regarding these projections is in which year the projections should start (see Box 1). The conclusion of Box 1 was that 2008 was the last on trend year for employment, and for that reason it is an alternative year from which the projections might 'jump off'. Table 3 also presents the results of combining the alternative 2008 jump-off year with the high, central, and low output growth scenarios above. Under a high output growth scenario employment is estimated to grow to 6.50 million by 2041 – this is 4.9 per cent (or 0.30 million) above the central scenario (and 2016 jump off point) presented in this paper.

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[23] At London labour market projections 2017 | London City Hall
[24] This was the forecast available at the time of completion of the projections. See Economic and fiscal outlook – March 2018 - Office for Budget Responsibility, and from where it is possible to access previous forecasts

Box 2: An alternative method of estimating future employment in the South East of England?

In 2003 GLA Economics considered an alternative methodology to estimate long-run employment (Working Paper 4: Long-term Employment Projections for London, GLA Economics). The methodology employed is repeated here - using projections of the population and the employment rate - to see what it may suggest for employment levels in 2041. Under this alternative model the assumption is made to hold the employment rate constant. Some may argue that results from such a model present a potential underestimate because, for example, of the likely impact from changes in the state pension age and abolition of the compulsory retirement age. However, such impacts would need to be balanced against factors that may reduce the employment rate, such as the raising of the participation age for young people. Nonetheless, given the complexity of the labour market, arguments suggesting the long-run employment rate may move in either direction, and the historic trends in the South East of England's employment rate (see Figure C) this could be considered a reasonable alternative approach against which to benchmark the central projections in this paper.

Figure C: South East of England's historic 16–64 working age employment rate
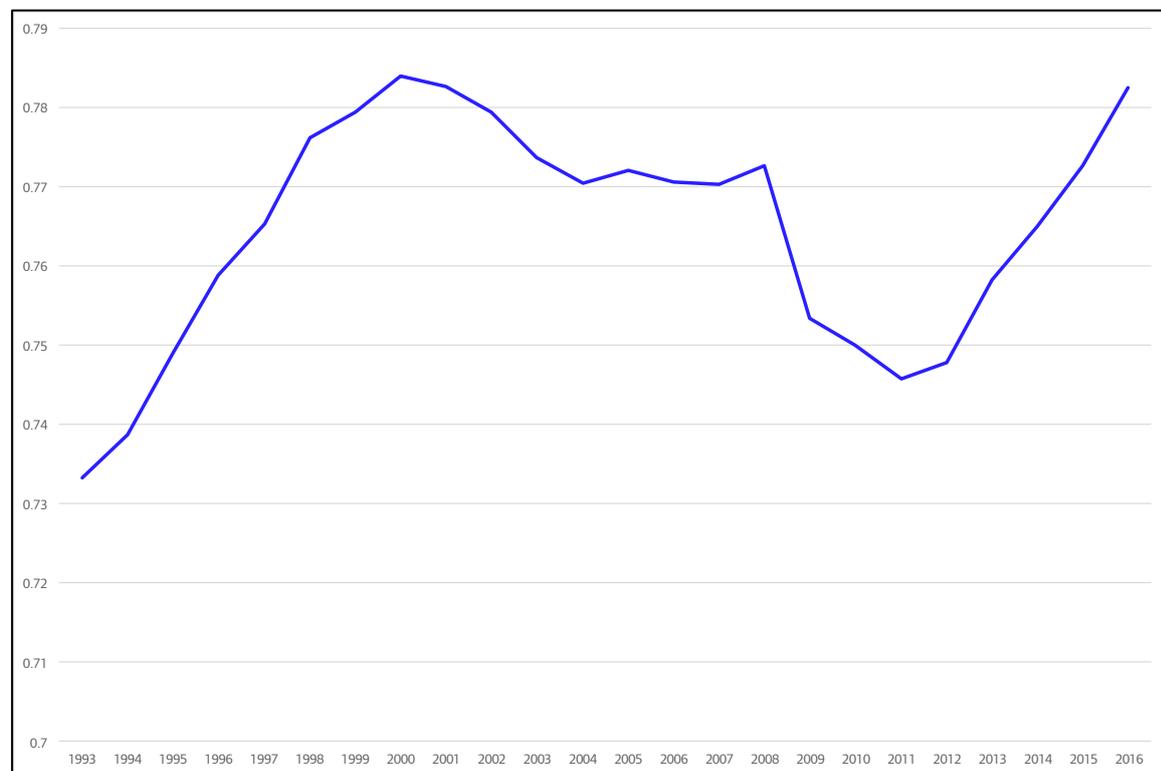
Source: Annual Population Survey, ONS

Under this alternative methodology (for which further details, including data sources and limitations, are provided in Appendix C) jobs in the South East of England are estimated to reach 5.21 million in 2041 – representing an average annual increase of 0.28 per cent, or an additional 14,110 jobs per annum. This estimate lies outside the range of those in the sensitivity testing. Indeed, as this alternative method is based on the working age population, does not include older workers, and has methodological limitations, it may be considered a cautious alternative.

Box 2 continued

Further, this estimate rests on the projected population increase. It is worth noting that the projected working age (16-64) population increase for 2016-41 for the South East of England is 460,000 people. This is less than the ONS estimate of working age population increase for the shorter period from 2001 to 2016, and so there is also an assumption of a sharp slowing down in population growth. As a consequence, a constant employment rate jobs projection has a sharp slowing down in jobs growth compared to historic trends.

Employment projections for the South East of England's sectors

Sector level projections for the South East of England are constructed using the same trend-based methodology as is used for the South East of England's total employment in the previous chapter. The data for employment across sectors comes from the same data sources for 1981–2016, with the productivity measure used being sector employment over South East of England GVA.

Charts showing the logged employment over South East of England output for each sector are presented in Appendix D.

As a final step to producing sector employment projections the results across sectors are constrained to the South East of England total projections above to reconcile them.

Table 4 shows the trends identified to use in projecting for each of the sectors as well as summary information on the resultant projections. Figures 3a and 3b show the projected employment levels.

Jobs in the Professional, real estate, scientific and technical sector are expected to grow strongly, accounting for over a third of the total increase expected in the South East of England to 2041. Strong employment growth is also expected in the Information and communication technologies, Education and Health sectors – collectively accounting for nearly 75% of the expected total South East of England increase to 2041.

On the other hand, employment in Primary and utilities, Manufacturing, Finance, and Public administration and defence sectors are all expected to decline over the period to 2041.

Table 4: Summary of trends used and results for sector employment projections

	Trend for projections to 2041	Long term output growth required for stable employment	Employment growth per annum with projected South East of England output growth	Annual average growth in jobs with projected South East of England output growth
Primary & utilities	1/2 trend from 1984 to 2016 1/2 trend from 2003 to 2016	2.0%	0.0%	-30
Manufacturing	from 2012 to 2016	2.9%	-0.5%	-1260
Construction	from 1990 to 2016	0.9%	0.6%	2090
Wholesale	from 1981 to 2016	2.0%	0.1%	260
Retail	from 1981 to 2016	1.2%	0.4%	2010
Transportation and Storage	4/5 trend from 1981 to 2016 1/5 trend from 2002 to 2016	1.3%	0.3%	600
Accommodation and food service	from 1981 to 2016	0.6%	0.9%	3310
Information and Communication	4/5 trend from 1981 to 2016 1/5 trend from 2015 to 2016	-0.5%	1.8%	6540
Financial and insurance activities	1/2 trend from 1989 to 2016 1/2 trend from 2005 to 2016	2.0%	-0.1%	-90
Professional, Real Estate, Scientific and technical activities	from 1981 to 2016	-1.3%	2.5%	18690
Administrative and support service activities	from 2001 to 2016	0.2%	1.2%	5310
Public Administration and defence	1/5 trend from 1995 to 2016 4/5 trend from 2015 to 2016	2.4%	-0.2%	-270
Education	from 1981 to 2016	2.0%	1.2%	6610
Health	from 1981 to 2016	0.3%	1.1%	7070
Arts, entertainment and recreation	from 1981 to 2016	-0.1%	1.5%	2450
Other services	9/10 trend from 1981 to 2016 1/10 trend from 1999 to 2016	1.5%	0.2%	210
Total South East of England Jobs	**medium term** (2016 to 2018) from 2007 to 2016 **long term** (2019 to 2041) from 1993 to 2016	0.5%	1.0%	53530

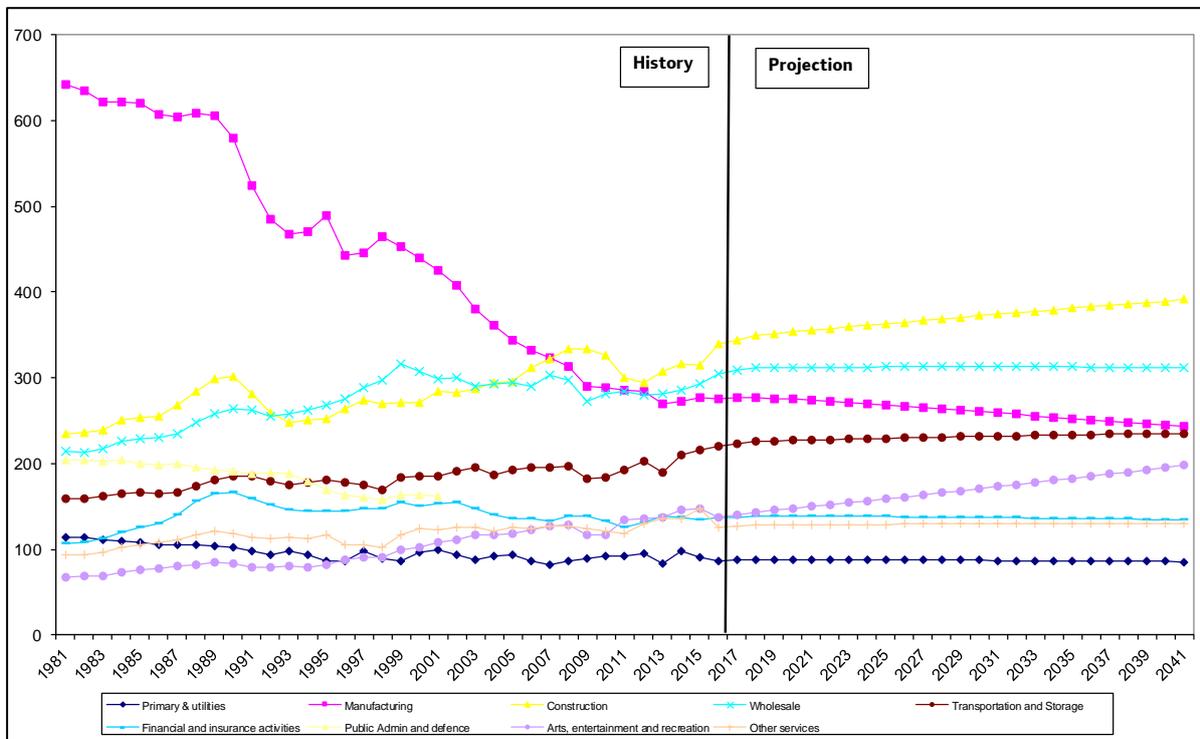Notes: Medium term output growth rate is 2.0%, and long-term output growth rate is 2.0%
Numbers may not add due to rounding

Figure 3a: Historic and projected employment ('000s) in the South East of England's largest sectors, 1981 to 2041
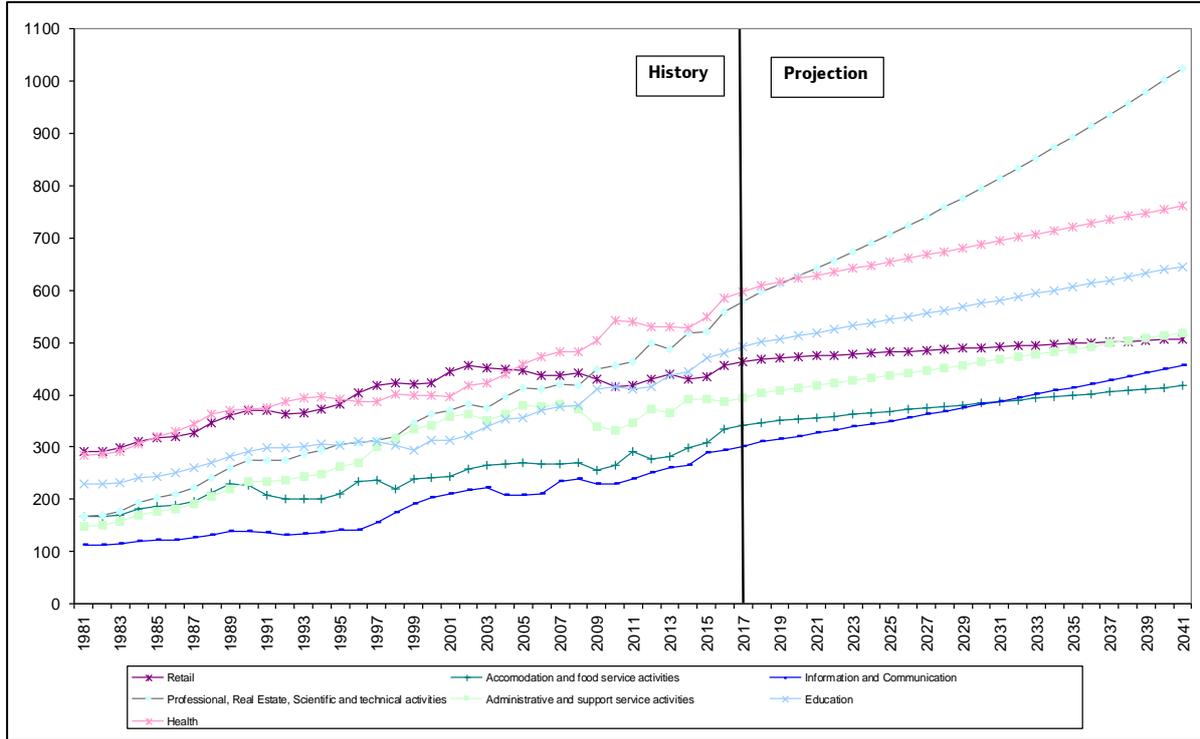
Source: GLA Economics

Figure 3b: Historic and projected employment ('000s) in the South East of England's smaller sectors, 1981 to 2041

Source: GLA Economics

Appendix A: Methodology for GLA Economics' trend-based medium-term projections

Box 1 considers the rationale for the trend-based methodology GLA Economics employs for its medium-term projections. Below is the algebra underlying the model:

Starting with a simple production function:

$$Y = ALe^{\beta t} \qquad\qquad (1)$$

where Y is output and L is employment.

It is assumed that in the medium term the rate of growth of potential output is given by:

$$Y_{trend} = Y(0)e^{\gamma t} \qquad\qquad (2)$$

The main paper explains that in the medium term the rate of growth of potential output in the South East is 2.0%, ie γ=0.02, and that over the longer term the rate of growth remains at 2%.

In the absence of constraints[25], in the medium term actual output is assumed to be equal to potential. So (1) can be re-written as:

$$Y(0)e^{\gamma t} = ALe^{\beta t} \qquad\qquad (3)$$

and solving for the potential level of demand for employment, subsuming the constant terms Y(0) and A as appropriate into a single term, k1.

$$L_{trend} = k1\ e^{(\gamma - \beta)t} \qquad\qquad (4)$$

This is the level of employment which would enable the trend rate of growth to be sustained.

The parameter β is not however time-invariant in the model. Instead, historical data is used to inform a linear function for projecting β into the future.

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[25] Strictly speaking, it is implicitly assumed that whatever constraints may have existed in the past continue into the future. Hence it is any *additional* constraints which are relevant.

Appendix B: Methodology for producing a range of on-trend employment projections

As mentioned in Box 1, GLA Economics looked at a number of economic commentators to see when they estimated the UK economy to be on trend to produce a range of possible on-trend employment projections. Specifically, GLA Economics looked at the output gap estimates from the following organisations:

- European Commission (EC):
  - Hodrick-Prescott (HP) filter based estimates
  - Production function based estimates
- IMF
- OECD
- Office for Budget Responsibility (OBR)

These estimates were then assessed using three methodologies to try to attain employment levels which correspond to the economy being on-trend. These three methods were:

1. Taking the on-trend years (and employment in those corresponding years) as those where the estimated output gap changed sign between two consecutive years and taking the year where the absolute value of the estimated gap is closest to zero,
2. Taking the on-trend year as all those where the absolute value of the estimated output gap is less than or equal to 0.5 per cent,
3. Combining the resulting years from the two methods above.

Once the year's corresponding to the three methods above had been collated the corresponding employment in those years was selected and interpolated to generate estimates for in-between years. Finally, a line of best fit was applied to these and projected forward. Outlier trends from the results were then excluded.

In addition to the estimates generated from the methodology above, two additional estimates were created using historic employment data alone. The first of these took both the peak and trough levels of employment over time and interpolated between them (i.e. interpolated between each peak to peak employment level and each trough to trough employment level separately). A line of best fit was then applied through each and forecasted forwarded and the average of the two lines was taken. The second estimate took the average between the interpolated peak to peak and trough to trough lines before a line of best fit was applied and projected forward.

Appendix C: Further information on an alternative method of estimating future employment in the South East of England

The methodology for the alternative method of estimating future employment works as follows.

Let the subscripts (S) denote the South East of England and (N) denote locations outside the South East of England,

Let J_{IK} = Jobs in location I filled by people from location K. So, for example, J_{NS} is jobs outside the South East of England (N) filled by people from the South East of England (S).

And let $G(x)$ = growth of the variable x, so $G(J_{NS})$ is the growth in jobs outside the South East of England filled by people from the South East of England.

The South East of England's employment on a residence basis is given by:

$$E_S = J_{SS} + J_{NS} \qquad\qquad (1)$$

Similarly the South East of England's employment on a workplace based (J_E) basis is given by:

$$J_S = J_{SS} + J_{SN} \qquad\qquad (2)$$

Now $G(E_S) = G(J_{SS}) = G(J_{NS})$ (3), if J_{SS}/E_S is constant over time. This is equivalent to saying that J_{NS} / E_S is also constant over time, i.e. the proportion of the South East of Englanders employed who fill jobs out of the South East of England is constant. Figure C1 shows that the share of jobs filled by the South East of Englanders working outside of the South East of England (out-commuting) has been relatively constant, if rising slightly over the period[26].

Similarly $G(J_S) = G(J_{SS}) = G(J_{SN})$,   (4) if J_{SS}/J_S or equivalently J_{SN}/J_S is constant over time. Note J_{SN}/J_S is the proportion of jobs in the South East of England that are filled by non-South East of Englanders commuting into the South East of England. Figure C2 shows the share of jobs in the South East of England filled by those in-commuting. Across the period this share has remained fairly stable.

If both equations (3) and (4) above hold it follows that since both $G(E_S)$ and $G(J_S)$ equal $G(J_{SS})$ then $G(E_S)$ and $G(J_S)$ are also equal to each other. That is that the growth in employment in the South East of England on a workplace basis is equal to the growth in employment in the South East of England on a residence basis.

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[26] Although this slight change, in itself, should be treated with caution as it may simply be due to sampling variability.

Figure C1: Jobs not in the South East of England filled by working age South East of Englanders as a proportion of all working age people employed in the South East of England
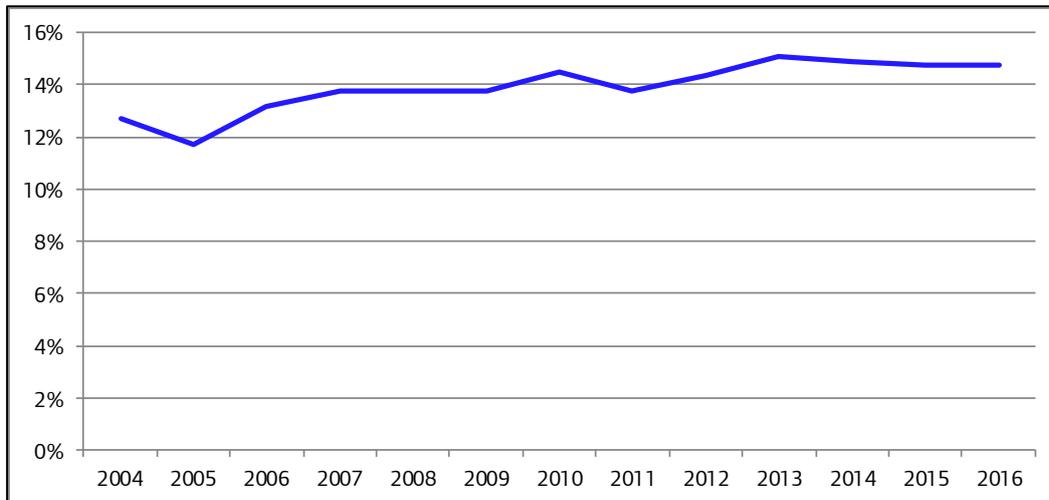
Source: APS, January-December, ONS

Figure C2: Share of jobs in the South East of England filled by working age non-South East of Englanders in-commuting
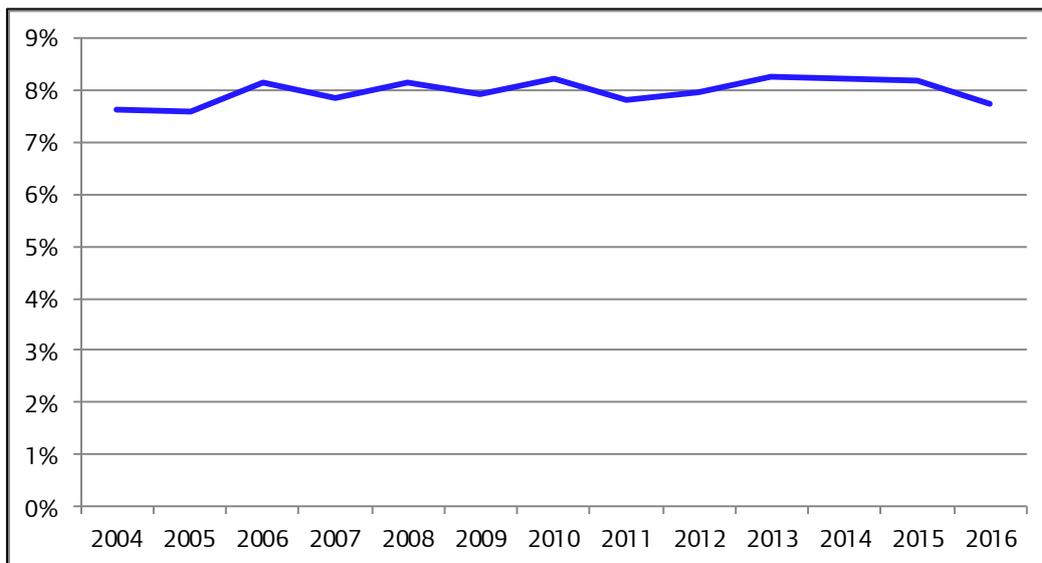
Source: APS, January-December, ONS

In other words, employment in the South East of England on a workplace basis can be estimated by estimating employment in the South East of England on a residence basis. The latter itself can be estimated by applying a projected employment rate to projections of the South East of England's population jumping off from 2016. For this, the working age employment rate is assumed as the average, 76.5%, of annual employment rates for 1993-2016. This is then applied to the working age population projection from the GLA 2016 round of demographic projections (trend-based population projections, long-term migration scenario)[27]**.** Since the employment estimate has been confined to the working age population alone the results from this methodology may be considered a cautious alternative.

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[27] Available at Population Projections – London Datastore

Appendix D: Historic sectoral employment charts

Figure D1: Log of primary and utilities employment as a proportion of total output in the South East of England, 1981–2016

Figure D2: Log of manufacturing employment as a proportion of total output in the South East of England, 1981–2016
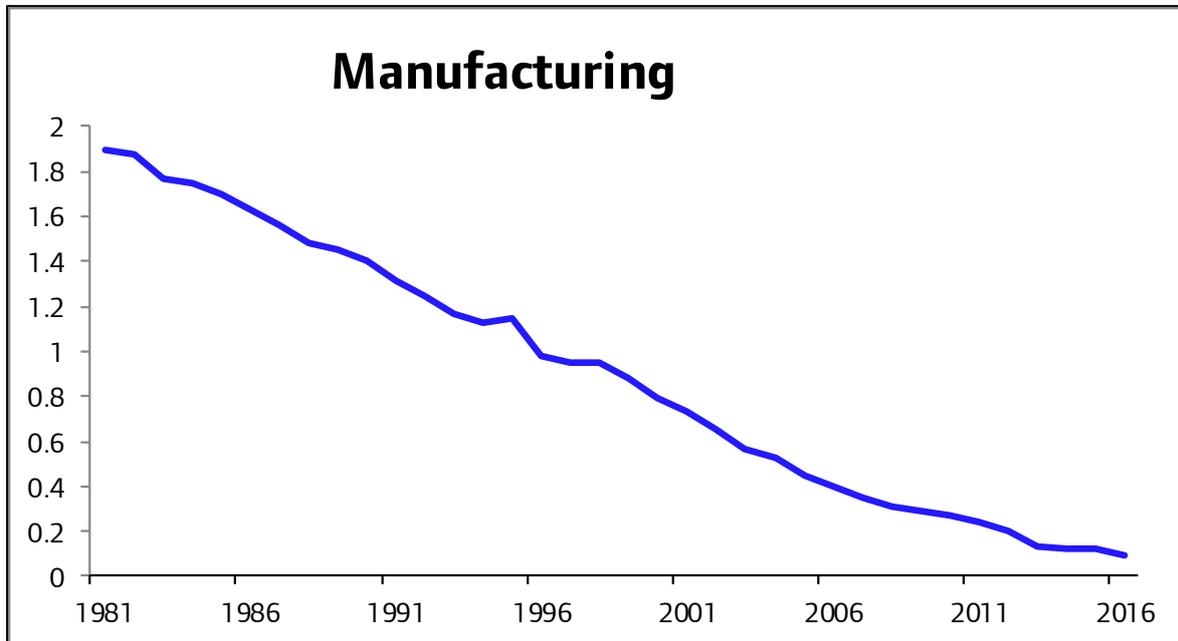
Figure D3: Log of construction employment as a proportion of total output in the South East of England, 1981–2016
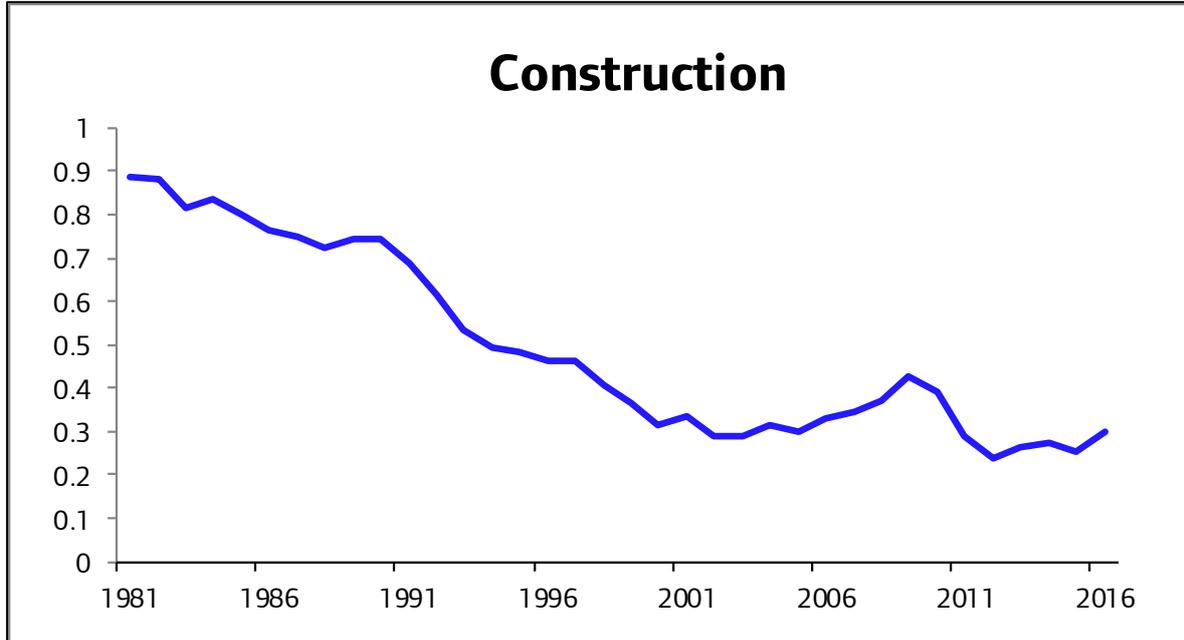
Figure D4: Log of wholesale employment as a proportion of total output in the South East of England, 1981-2016
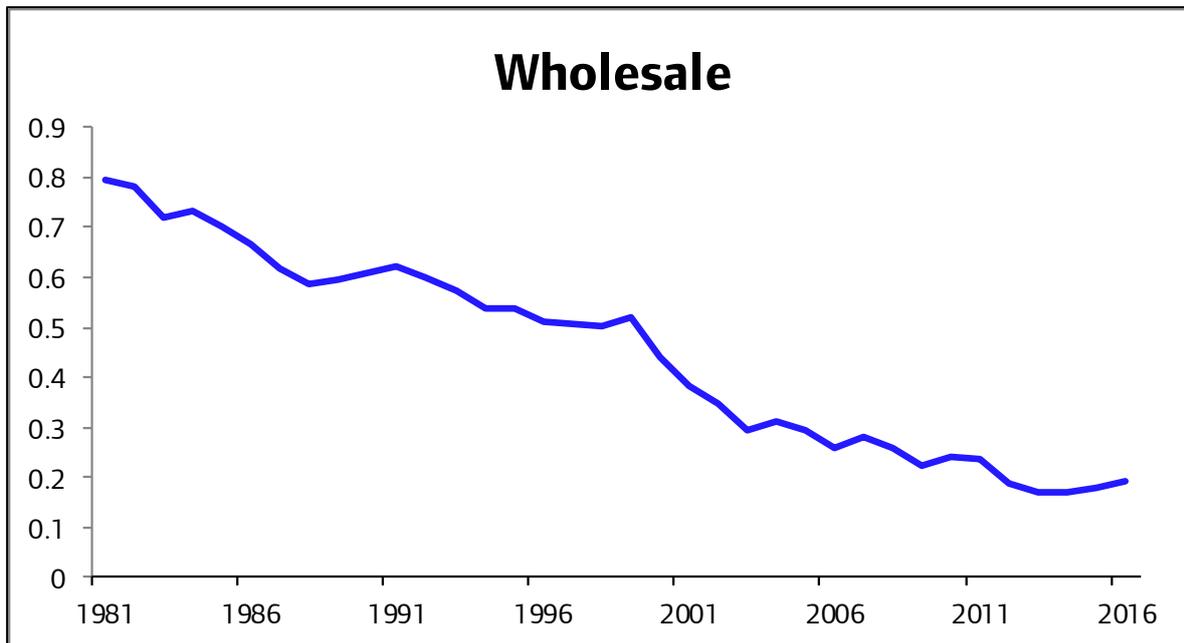
Figure D5: Log of retail employment as a proportion of total output in the South East of England, 1981-2016
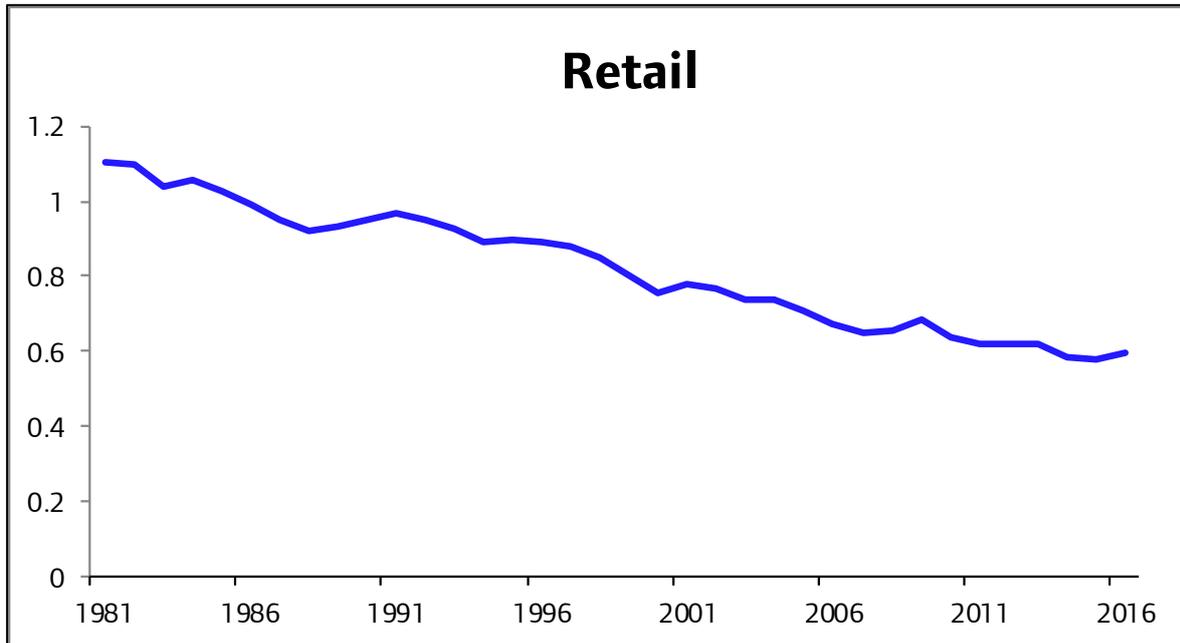
Figure D6: Log of transport and storage employment as a proportion of total output in the South East of England, 1981-2016
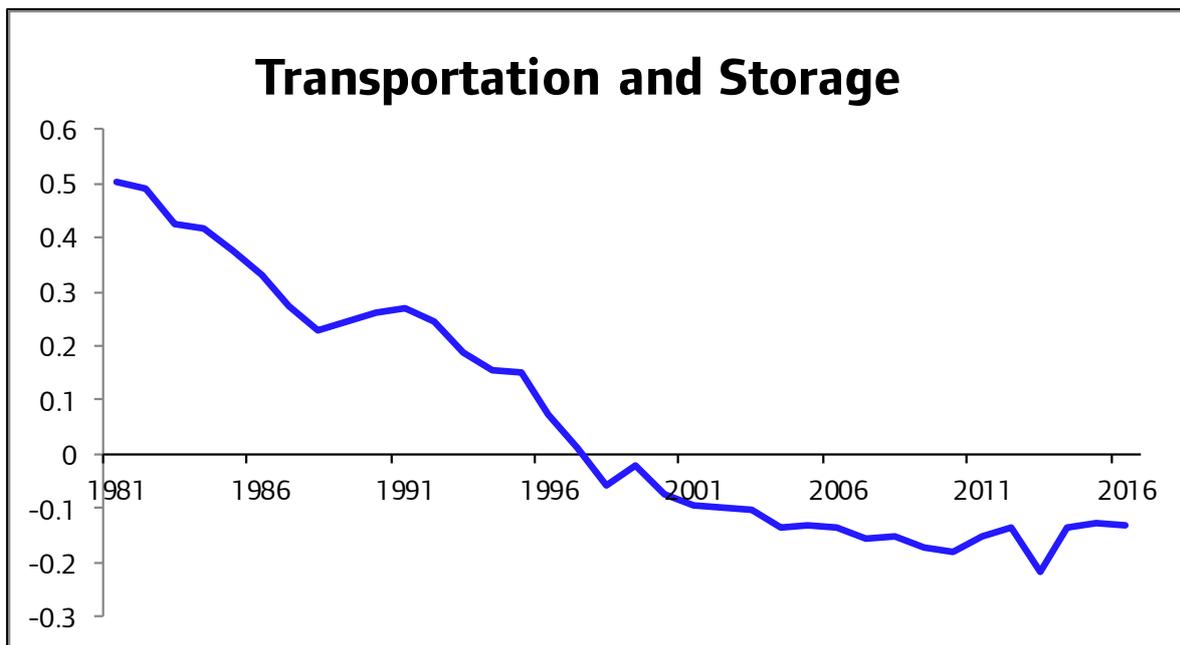
Figure D7: Log of accommodation and food service activities employment as a proportion of total output in the South East of England, 1981–2016
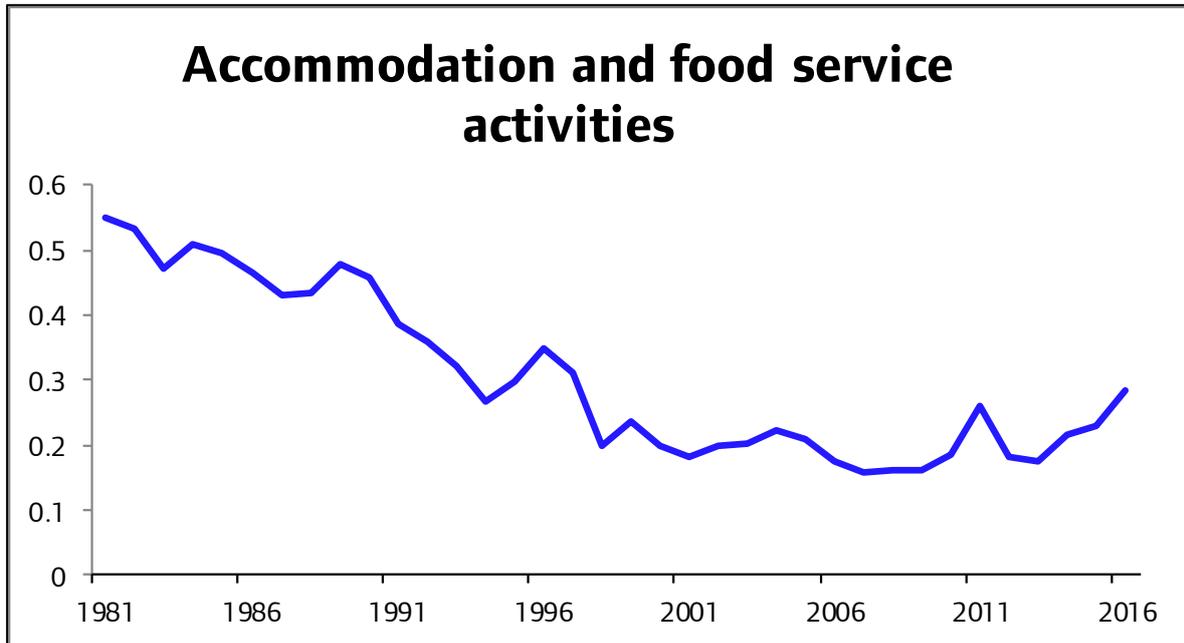
Figure D8: Log of information and communication employment as a proportion of total output in the South East of England, 1981–2016
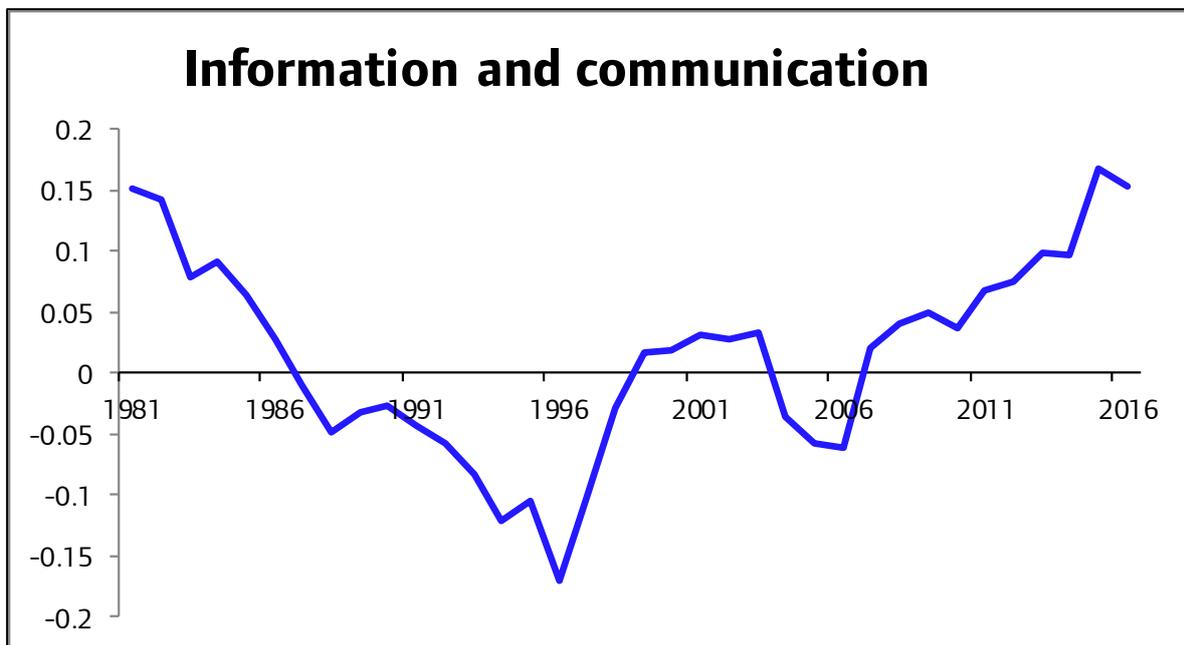
Figure D9: Log of financial and insurance activities employment as a proportion of total output in the South East of England, 1981–2016

Finance and insurance activities
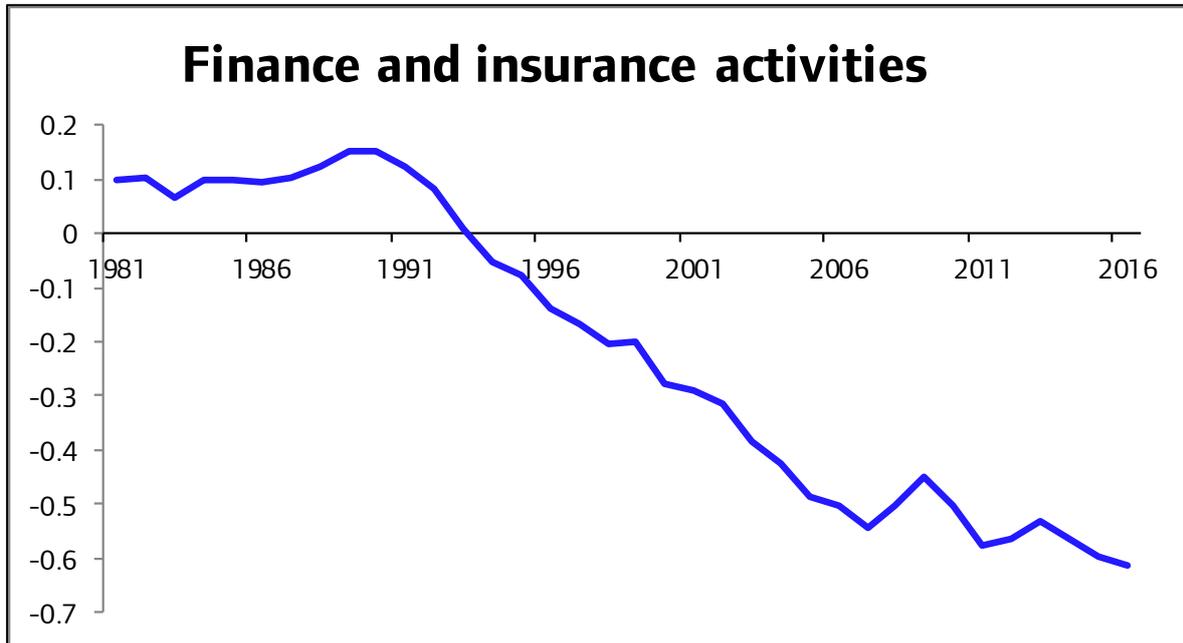
Figure D10: Log of professional, real estate, scientific and technical activities employment as a proportion of total output in the South East of England, 1981–2016

Professional, Real Estate, Scientific and technical activities
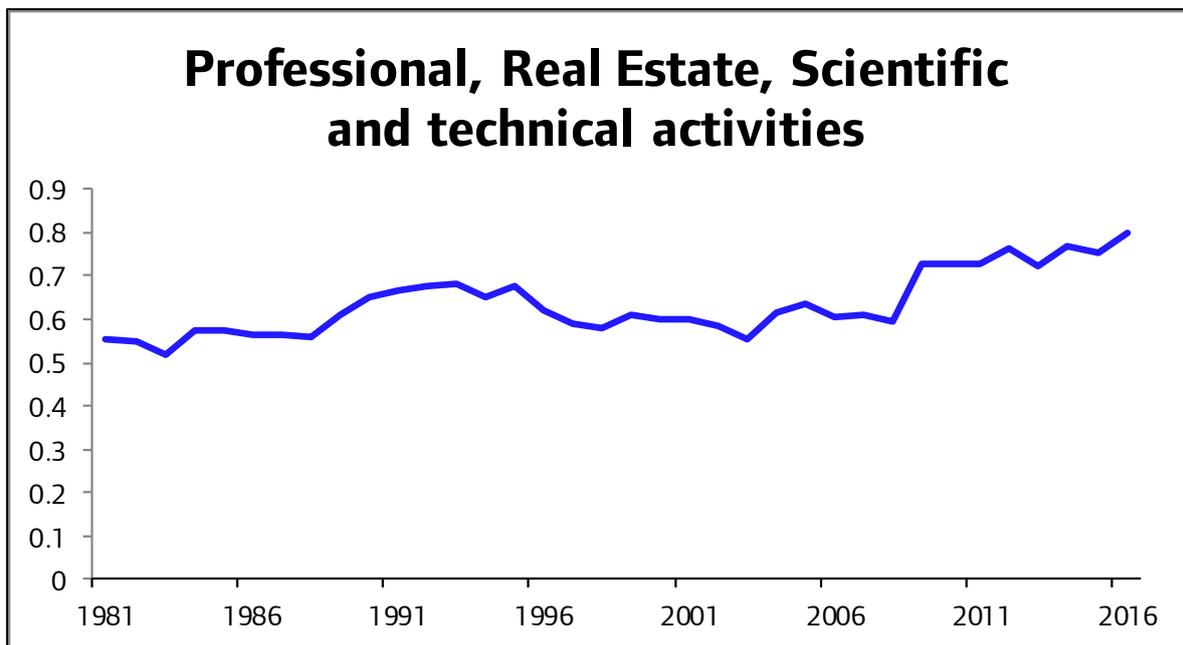
Figure D11: Log of administrative and support service activities employment as a proportion of total output in the South East of England, 1981–2016

Administrative and support service activities
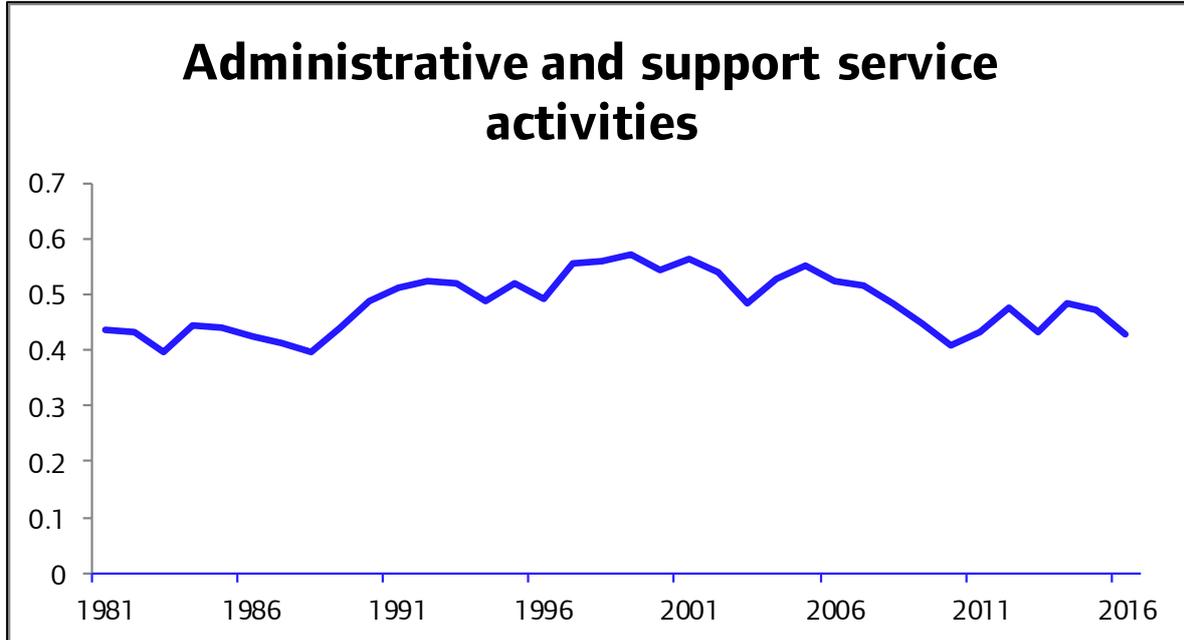
Figure D12: Log of public administration and defence employment as a proportion of total output in the South East of England, 1981–2016
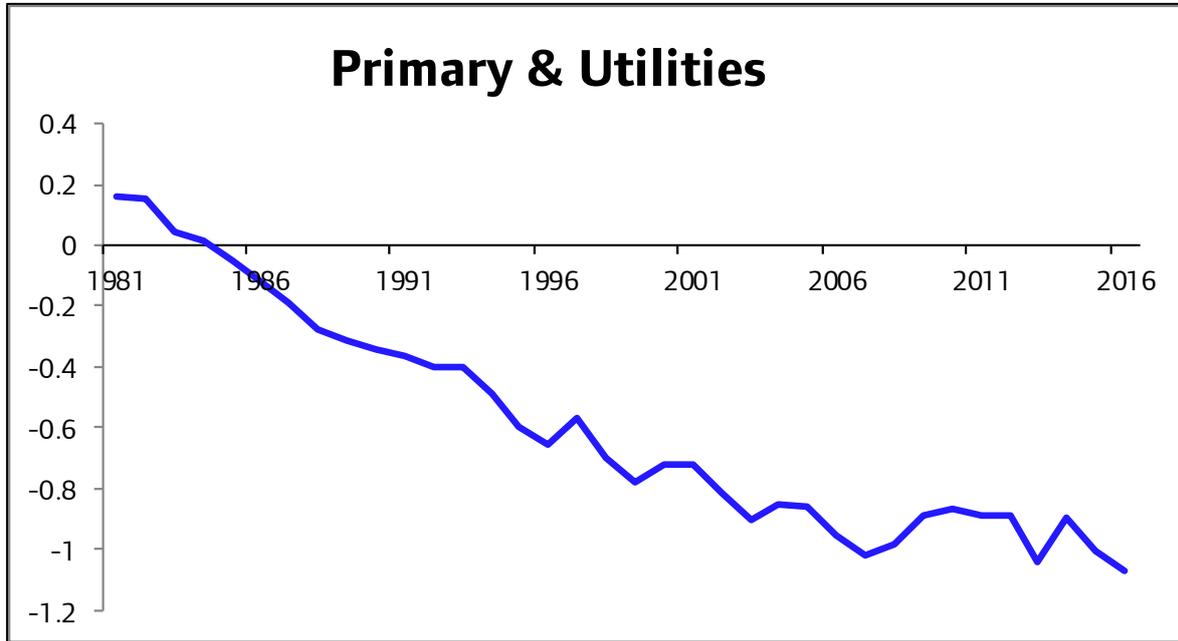

Public administration and Defence
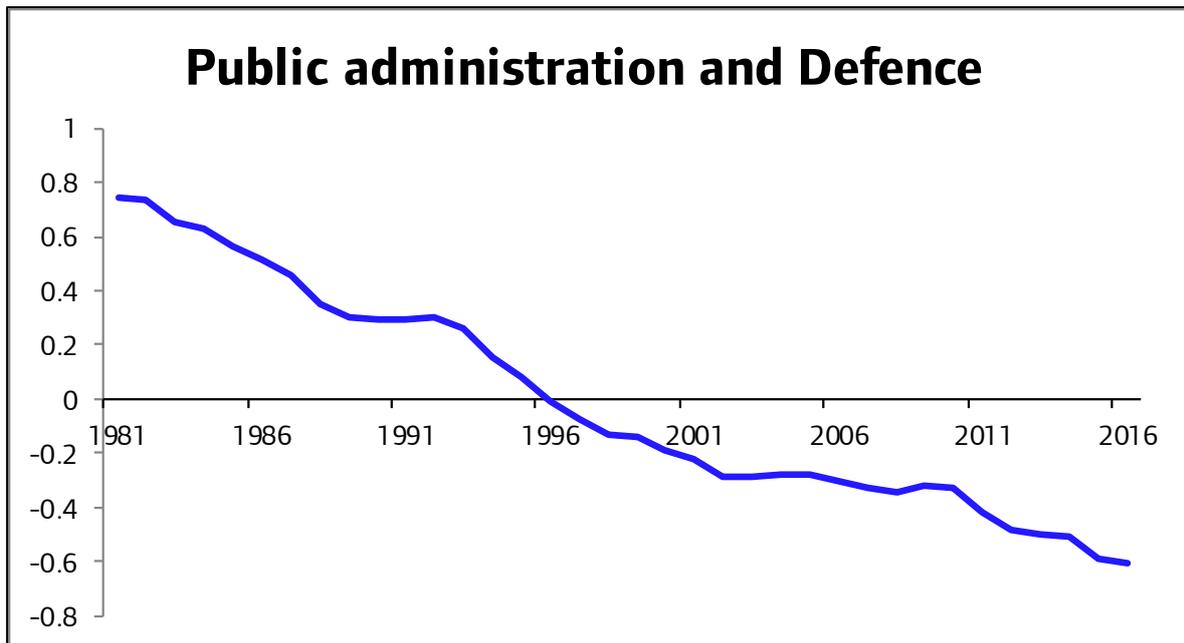
Figure D13: Log of education employment as a proportion of total output in the South East of England, 1981-2016
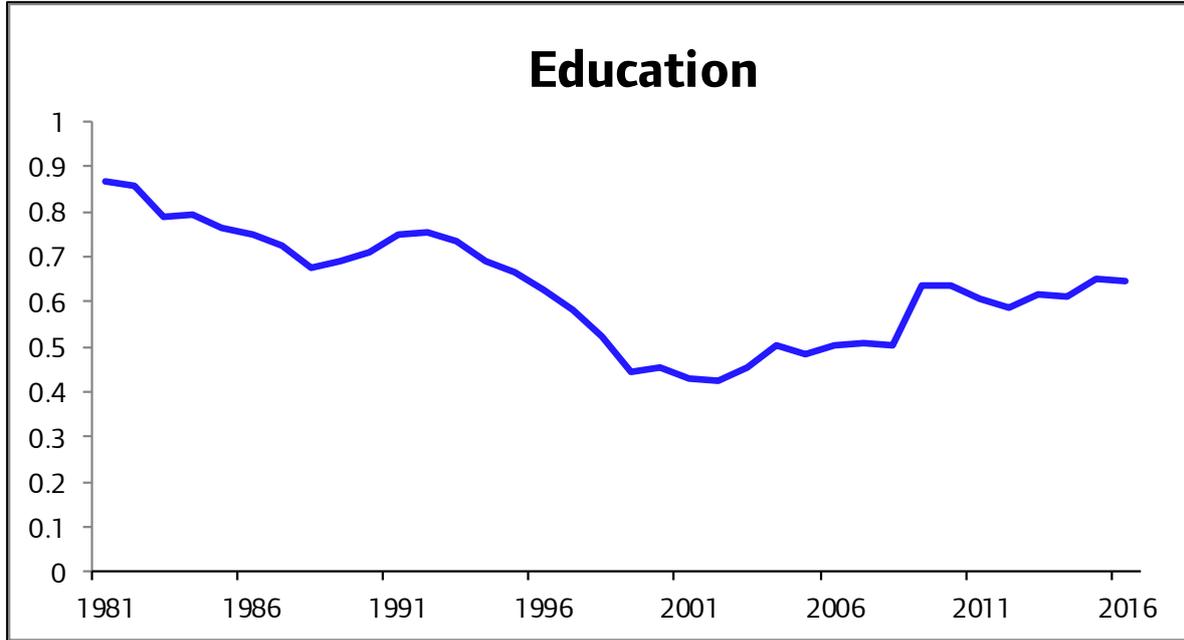
Figure D14: Log of health employment as a proportion of total output in the South East of England, 1981-2016
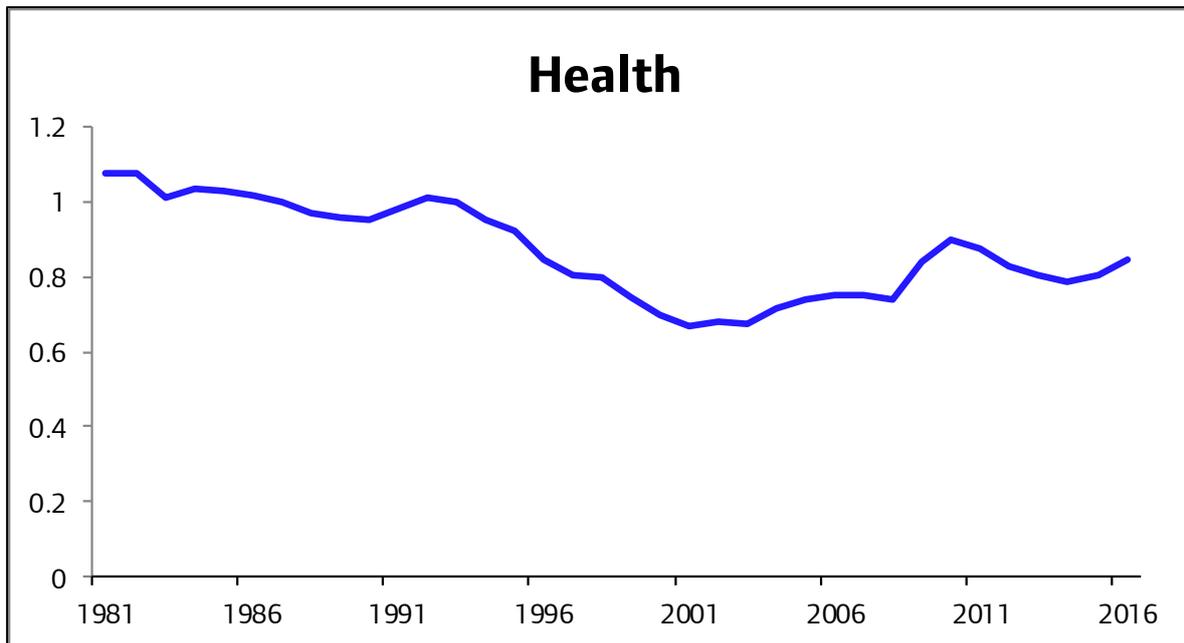
Figure D15: Log of arts, entertainment and recreation employment as a proportion of total output in the South East of England, 1981–2016

Arts, entertainment and recreation
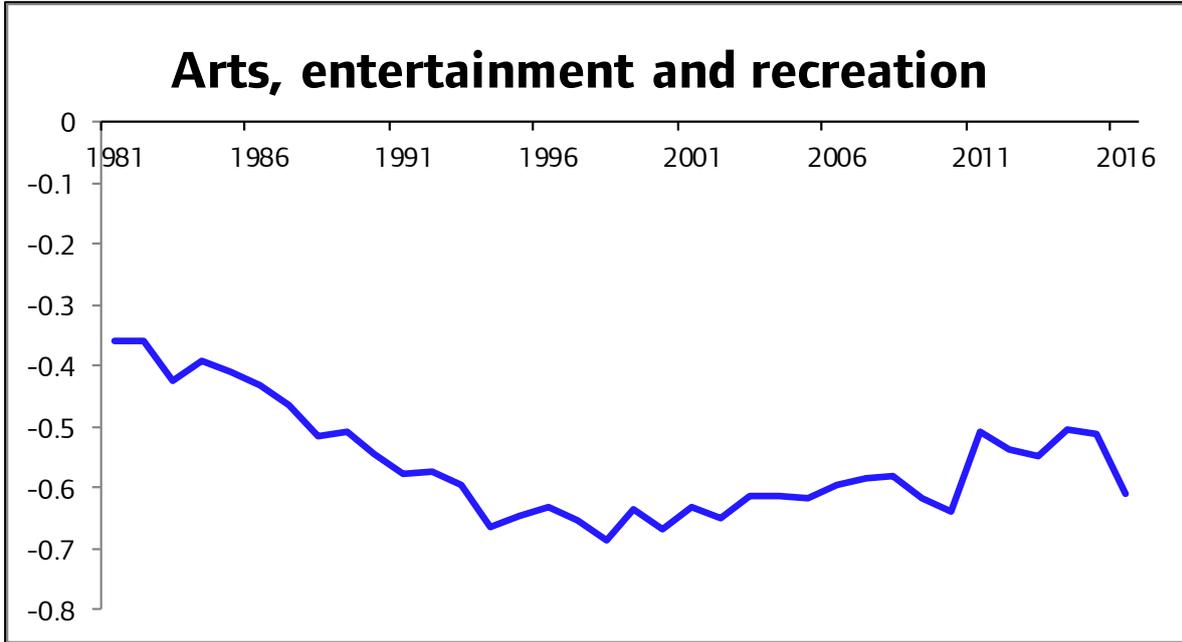
Figure D16: Log of other services employment as a proportion of total output in the South East of England, 1981–2016

Other services
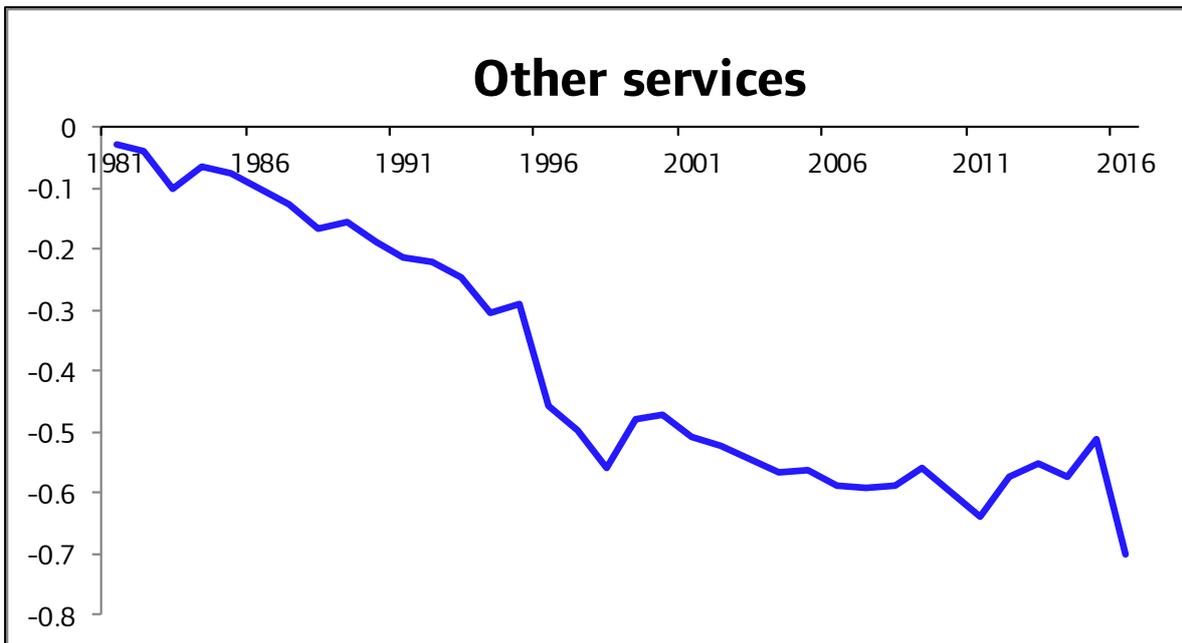
Appendix E: Developing a jobs back series to 1981 for the South East of England

E.1. Introduction

This paper describes the data and methodology used to construct an experimental back series on the South East of England's jobs and output back to 1981. This work builds on the expertise acquired by GLA Economics in previous reports for a London Jobs series[28] and a London Workforce Employment series[29], to provide a backcast series for the purpose of producing long-term employment projections.

Understanding the history and relationship between jobs and output in the South East of England forms a key part of producing long-run employment projections for the South East of England, as well as long-term trends in its key sectors.

There are official ONS statistics for:

- Employee jobs, for the region and by sector, back to 1981
- Self-employment jobs, for the region, and by sector, back to 1996
- Output as measured by GVA back to 1997

This data is part of the historic data series used to inform the projections. This analysis of this Appendix addresses the gap by backcasting the self-employment and GVA series to 1981 so that productivity estimates of output per job are available from 1981 to 2016.

This Appendix covers the development of:

- A split of the wholesale and retail employee and self-employment jobs series to 1981;
- A self-employment job series to 1981;
- A self-employment by sector job series to 1981;
- A GVA series to 1981.

In each section, possible approaches to create the back series are tested and reviewed, and the results compared as a 'sense check' with the back series produced by economic forecasters. The external forecasters are referred to as 'Forecaster A', and 'Forecaster B'[30]. The third back series for the East and South East of England is for jobs and had been developed for the GLA by Experian[31]. It is the equivalent of the London Workforce Employment series[32] for these regions.

There are separate sections on jobs and GVA which provide some context on definitions.

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[28] See, Working Paper 52: London's jobs history – a technical paper, December 2011, and for the methodology to backcast the series to 1971 London labour market projections 2016 | London City Hall

[29] See, The GLA's London Workforce Employment Series | London City Hall, 2003, and with updated methodology Current Issues Note 11: Revisions to GLA workforce employment series | London City Hall, 2006

[30] The comparisons are with the series as available at Autumn 2016, which is the time when this analysis was conducted. Some estimates have been imputed using GLA Economics data where the forecaster does not estimate a particular series of interest.

[31] This series goes back to 1982, and is no longer maintained

[32] See The GLA's London Workforce Employment Series | London City Hall

E.2. Basis for comparison between time series

Where there are comparisons between time series, these use a number of tests, previously employed by GLA Economics[33] to evaluate the performance of employment projections, and which measure the extent to which the respective time series:

- Do not exhibit bias, i.e. not consistently underestimate or overestimate established series on a regular basis; and
- Are accurate or close to the series to be backcast over the period where there is data for both series.

The statistical measures used to evaluate the series are:

- Compound annual rate of growth (CAGR) – the average year on year growth between two points in time.
- Difference in CAGR between two series
- Correlation coefficient – measures how closely (in direction and magnitude) two series move
- Cumulative sum of difference – adds up the difference in each year between two series
- Mean absolute deviation – measures the size of the average difference between two series over a number of years (regardless of the direction of the error).
- Mean absolute percentage difference – measures the average of the percentage differences between two series over a period of years, and thus provides an indication of the scale of the difference.

Additionally, in selecting the series to be used for backcasting linear regression results are also provided for comparison.

This work has been developed in parallel with the same analysis to backcast data series for the East of England, and published in a paper alongside this one. On grounds of simplicity GLA Economics has had a preference for making judgements on approaches to backcasting which are common to the series for both the East and South East of England. In support of this approach some of the figures in this Appendix include series for the East of England as well as the South East of England.

E.3. Employment data definitions

E.3.1. Jobs definition

Employment data can either refer to jobs or people measures, i.e. people can have more than one job, and jobs may be shared by more than one person. Employment data can also be recorded on a workplace or residence basis. GLA Economics' employment projections focus on jobs in the workplace regardless of whether they are filled by residents or commuters.

The Workforce jobs series is the main ONS jobs series. It estimates the number of jobs in an area, whether or not they are taken by residents of that area. The definition is:

> **Workforce jobs = employee jobs + self-employed jobs + HM forces + Government supported trainees**

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[33] See, CIN 40: Performance of GLA Economics' employment projections | London City Hall

In the South East of England, employee jobs and self-employed jobs account for over 99 per cent of the total Workforce jobs. Historically, GLA Economics have excluded HM Forces and Government supported trainees from jobs analysis, and for consistency these components are not included in the time series presented here, with employment therefore defined as employee jobs and self-employed jobs.

E.3.2. Sectors definition

The sector definition used for the South East of England projections follows the same definition as used for the London labour market projections. The London Jobs series is based on the ONS SIC 2007 classification[34]. SIC 2007 comprises 21 Sections (denoted by a single letter from A to U).   Sections T (activities of households as employers) and U (activities of extra-territorial organisations) have been excluded from the London jobs series as these sections are not covered by ONS business surveys.

The GLA combines Sections A, B, D and E into a new category, 'Primary and utilities', and sections L and M are combined into 'Professional, real estate, scientific and technical activities'.

A Wholesale/Retail split is also provided to divide the SIC 2007 Section 'Wholesale and retail trade; repair of motor vehicles and motorcycles'. Motor trades are included within the wholesale sector. ONS provides separate jobs series for the wholesale and retail sectors for the UK, but not for the regions. This is why GLA Economics has had to derive a jobs split for the South East of England region.

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[34] See UK SIC 2007 - Office for National Statistics

Table E.1 Comparison of ONS and GLA sector definitions

SIC 2007 Section level	GLA Economics sector
A: Agriculture, forestry and fishing	Primary and utilities
B: Mining and quarrying	
D: Electricity, gas, steam and air conditioning supply	
E: Water supply; sewerage, waste management and remediation activities.	
C: Manufacturing	Manufacturing
F: Construction	Construction
G: Wholesale and retail trade	Wholesale [including motor trades]
	Retail
H: Transportation and storage	Transportation and storage
I: Accommodation and food service activities	Accommodation and food service activities
J: Information and communication	Information and Communication
K: Financial and insurance activities	Financial and insurance activities
L: Professional, scientific and technical activities	Professional, Real Estate, Scientific and technical activities
M: Real estate activities	
N: Administrative and support service activities	Administrative and support service activities
O: Public administration and defence; compulsory social security	Public administration and defence
P: Education	Education
Q: Human health and social work activities	Health
R: Arts, entertainment and recreation	Arts, entertainment and recreation
S: Other service activities	Other services

Source: GLA Economics

E.4. Backcasting the split of wholesale and retail jobs

ONS publishes statistics for employee jobs and self-employment jobs for the wholesale and retail sector combined in the case of employee jobs back to 1981, and for self-employment jobs back to 1996. GLA has separate sectors for wholesale and retail, and so it is necessary to derive a split. ONS provides this back to 1996 through an additional release[35]. The next two sections discuss the approaches considered and adopted to backcasting self-employment jobs in aggregate, and by sector. This section looks at approaches to produce a wholesale-retail split for employee and self-employed jobs for 1981-95.

The series which might be used to backcast self-employment jobs all have a wholesale-retail split, so once a series is chosen it is possible to align separately to it[36].

There are various approaches which might be adopted to estimate the employee jobs split:

- Backcast the shares of wholesale and retail jobs to the UK jobs for these sectors, and calibrate to ONS estimates for the sector combined

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[35] See Employee and self-employed jobs in divisions of industry section G in the Greater South East, 1996 to 2016 - Office for National Statistics

[36] Employee jobs is one of the options, and this would be completed through the analysis described in this section.

- Backcast the trends in the South East of England employee jobs series and calibrate to ONS estimates for the sector combined
- Backcast the share of wholesale (or retail) employee jobs of the combined sector, and apply to ONS estimates for the sector combined

GLA Economics has backcast the split of wholesale and retail employee jobs by projecting back the share within the wholesale-retail sector. The third option has been chosen as each of the wholesale and retail shares of employee jobs of the combined sector has been reasonably stable over time, Figure E.1.

Figure E.1 Wholesale shares of Wholesale and Retail employment jobs, employee jobs, and self-employment jobs, 1996-2015
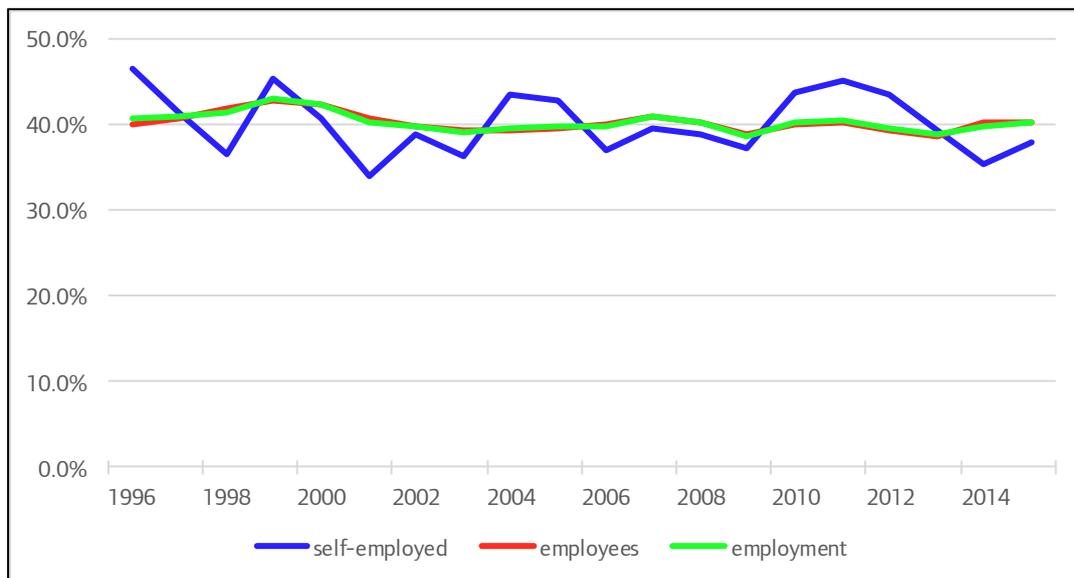
Source: ONS, Workforce Jobs series

E.5. Backcasting self-employment jobs

There is a self-employment jobs series for 1996-2015[37]. Three jobs series which are available from 1981-2015 have been considered as a comparator for a backcast self-employment series:

- UK self-employment jobs (option 1, an ONS series)
- London self-employment jobs (option 2, part of the GLA London Jobs series)
- South East of England employee jobs (option 3, an ONS series)

There are similar trends for self-employment jobs for the South East of England, East of England, and UK over the period 1996-2015 (Figure E.2). Growth over the period is similar for South East of England employee jobs although growth was higher up to 2008, and lower subsequently. Growth in self-employment jobs in London has been markedly higher over the period.

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[37] At the time the analysis was conducted data for 2016 and 2017 was not available

Figure E.2 Trends in self-employment jobs for the regions of the Wider South East and UK, and South East employee jobs 1996-2015, index numbers 1996=100
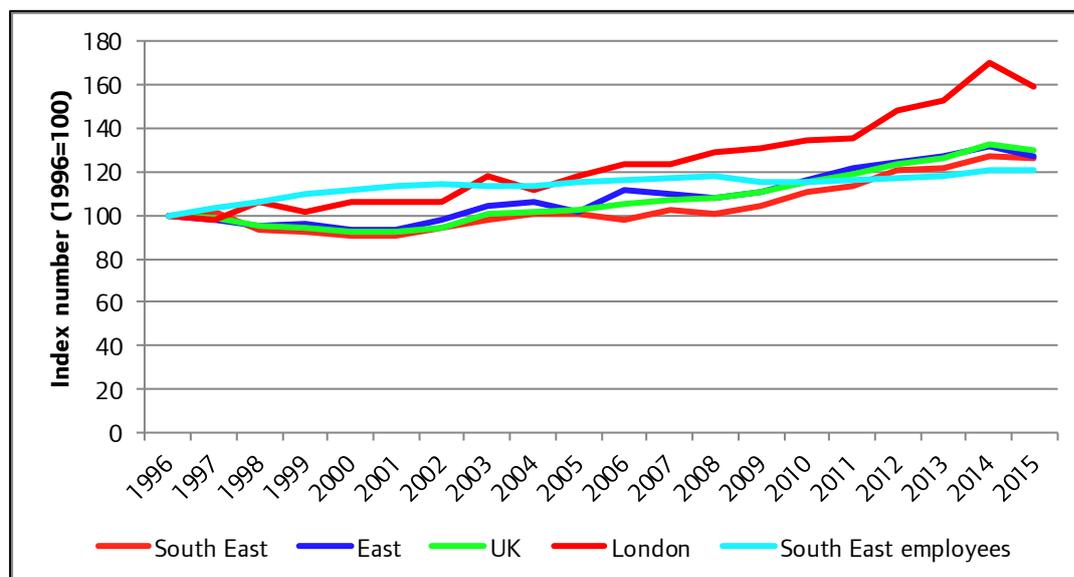
Source: ONS Workforce Jobs series, and GLA London Jobs series

A number of statistical tests have been conducted to explore the properties of the options for backcasting the South East of England self-employment jobs series, and reported at Table E.2. Across the range of metrics the series which mostly closely parallels the South East of England self-employment jobs is that for UK self-employment jobs.

Table E.2 Comparisons of statistical properties of options and tests for backcasting self-employment jobs series

	South East SEJ	UK SEJ	London SEJ	South East employee jobs
CAGR	1.2%	1.6%	2.7%	0.9%
Difference in CAGR	0.0%	0.3%	1.5%	-0.3%
Correlation coefficient	1.00	0.98	0.94	0.64
Cumulative sum of forecast differences	0	63	391	189
Mean absolute deviation	0	4	21	12
Mean percentage difference (%)	0	3	16	11
regression statistical significance				
x-coefficient		yes	yes	yes
intercept term		no	yes	no
F-statistic		yes	yes	yes

Source: GLA Economics calculations
Note: Job series have been expressed as index numbers, so results are comparable, and reflect growth trends, rather than relative sizes of populations

For this reason, **GLA Economics has backcast South East of England self-employment jobs as a constant share of UK self-employment jobs**. The use of the share of UK jobs rather than the back projection of a trend allows the backcast series to incorporate cyclical movements around the trend, as well as the trend.

A comparison of backcast series from the options for this analysis, and with external forecasters is at Table E.3. By these measures the back series of the chosen option is closer to the back series of Forecaster A and Experian than the other options considered in this paper.

Table E.3 Comparison of South East of England self-employment jobs series 1982-1996, GLA Economics options and back series of external forecasters

	Tested options for South East SEJ back series			External forecaster back series		
	UK SEJ (chosen)	London SEJ	South East employees	Forecaster A	Forecaster B	Experian
CAGR	3.2%	1.7%	1.3%	3.8%	2.0%	3.4%
Difference in CAGR	0.0%	-1.5%	-1.9%	0.6%	-1.1%	0.2%
Correlation coefficient	1.00	0.97	0.97	0.98	0.89	0.98
Cumulative sum of forecast differences	0	-505484	-749413	-6381	860513	-249363
Mean absolute deviation	0	42023	57568	15471	61465	19332
Mean percentage difference (%)	0	9	12	3	11	4

Source: GLA Economics calculations
Notes: Experian self-employment series spliced to ONS values for self-employed jobs at 1996

E.6. Backcasting self-employment sector jobs

There is a self-employment sector jobs series for 1996-2015[38]. As for all self-employment jobs three jobs series which are available from 1981-2015 have been considered as a comparator for a backcast self-employment series:

- UK self-employment jobs (option 1, an ONS series)
- London self-employment jobs (option 2, part of the GLA London Jobs series)
- South East of England employee jobs (option 3, an ONS series)[39]

Statistical analysis has been conducted to explore the properties of the options (Tables E.4a and E.4b), and to conduct tests of the options (Table E.5), for backcasting the South East of England self-employment sector jobs series. The general finding is that the UK self-employment jobs series is the closest series to the South East of England self-employment jobs series for most sectors and most measures. For the statistical tests (Table E.5) each option provides a good fit across sectors taken together, and the UK self-employment series is no worse than the other options.

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[38] At the time the analysis was conducted data for 2016 and 2017 was not available
[39] A split of the wholesale and retail sectors is not available for this series prior to 1996. The split from 1996 onwards is available at Employee and self-employed jobs in divisions of industry section G in the Greater South East, 1996 to 2016 - Office for National Statistics.

Table E.4a Comparisons of statistical properties of options for backcasting self-employment sector jobs series, 1996–2015, part 1

	CAGR			
	South East SEJ	UK SEJ	London SEJ	South East employees
Primary and utilities	-0.9%	-0.3%	0.0%	-0.5%
Manufacturing	-2.0%	-1.0%	-2.5%	-2.9%
Construction	0.3%	1.2%	4.2%	1.9%
Wholesale & retail	-1.5%	-1.3%	-0.5%	0.2%
Transportation and storage	1.1%	1.5%	2.9%	1.2%
Accommodation and food services	-3.4%	-0.9%	-3.3%	1.8%
Information and communication	1.5%	2.3%	2.1%	3.1%
Financial and insurance activities	4.7%	2.8%	7.2%	-0.5%
Professional and real estate	1.3%	2.7%	2.8%	3.0%
Administrative and support services	3.6%	4.3%	4.7%	1.4%
Public administration and defence	9.4%	6.5%	2.1%	-1.1%
Education	7.2%	6.3%	7.4%	1.7%
Health and social work	1.0%	1.9%	2.1%	1.7%
Arts, entertainment and recreation	3.5%	2.8%	2.7%	2.4%
Other service activities	4.1%	-0.3%	0.0%	-0.5%
	Difference in CAGR			
	South East SEJ	UK SEJ	London SEJ	South East employees
Primary and utilities	0.0%	0.6%	0.9%	0.4%
Manufacturing	0.0%	0.9%	-0.6%	-0.9%
Construction	0.0%	0.8%	3.9%	1.6%
Wholesale & retail	0.0%	0.2%	1.0%	1.7%
Transportation and storage	0.0%	0.4%	1.8%	0.0%
Accommodation and food services	0.0%	2.4%	0.1%	5.2%
Information and communication	0.0%	0.8%	0.6%	1.6%
Financial and insurance activities	0.0%	-1.8%	2.6%	-5.2%
Professional and real estate	0.0%	1.4%	1.4%	1.7%
Administrative and support services	0.0%	0.7%	1.1%	-2.2%
Public administration and defence	0.0%	-2.8%	-7.2%	-10.5%
Education	0.0%	-1.0%	0.2%	-5.6%
Health and social work	0.0%	0.9%	1.1%	0.7%
Arts, entertainment and recreation	0.0%	-0.7%	-0.8%	-1.1%
Other service activities	0.0%	-4.4%	-4.1%	-4.6%
	Correlation coefficient			
	South East SEJ	UK SEJ	London SEJ	South East employees
Primary and utilities	1.00	0.73	0.19	-0.23
Manufacturing	1.00	0.88	0.49	0.68
Construction	1.00	0.89	0.70	0.52
Wholesale & retail	1.00	0.80	0.46	-0.05
Transportation and storage	1.00	0.82	0.71	0.62
Accommodation and food services	1.00	0.35	0.03	-0.73
Information and communication	1.00	0.67	0.40	0.37
Financial and insurance activities	1.00	0.93	0.85	-0.82
Professional and real estate	1.00	0.87	0.76	0.78
Administrative and support services	1.00	0.95	0.85	0.15
Public administration and defence	1.00	0.89	0.12	-0.76
Education	1.00	0.98	0.97	0.89
Health and social work	1.00	0.82	0.61	0.79
Arts, entertainment and recreation	1.00	0.94	0.77	0.67
Other service activities	1.00	0.53	-0.03	-0.48

Source: GLA Economics calculations
Note: Job series have been expressed as index numbers, so results are comparable, and reflect growth trends, rather than relative sizes of populations

Table E.4b Comparisons of statistical properties of options for backcasting self-employment sector jobs series, 1996-2015, part 2

	Cumulative sum of forecast differences			
	South East SEJ	UK SEJ	London SEJ	South East employees
Primary and utilities	0	-486	2174	-25
Manufacturing	0	325	485	250
Construction	0	191	452	958
Wholesale & retail	0	-31	57	361
Transportation and storage	0	69	-71	-193
Accommodation and food services	0	257	1129	1002
Information and communication	0	176	445	426
Financial and insurance activities	0	-1528	-431	-2335
Professional and real estate	0	2	-162	211
Administrative and support services	0	482	570	303
Public administration and defence	0	-1442	2746	-2397
Education	0	326	1421	-533
Health and social work	0	-112	230	65
Arts, entertainment and recreation	0	38	195	415
Other service activities	0	-624	2035	-163
	Mean absolute deviation			
	South East SEJ	UK SEJ	London SEJ	South East employees
Primary and utilities	0	26	116	21
Manufacturing	0	17	26	15
Construction	0	10	25	50
Wholesale & retail	0	6	8	20
Transportation and storage	0	7	16	12
Accommodation and food services	0	15	59	53
Information and communication	0	15	27	28
Financial and insurance activities	0	80	42	123
Professional and real estate	0	9	14	15
Administrative and support services	0	25	31	31
Public administration and defence	0	77	168	130
Education	0	18	75	42
Health and social work	0	10	21	10
Arts, entertainment and recreation	0	12	18	28
Other service activities	0	35	114	21
	Mean percentage deviation (%)			
	South East SEJ	UK SEJ	London SEJ	South East employees
Primary and utilities	0	32	45	20
Manufacturing	0	21	26	18
Construction	0	10	19	36
Wholesale & retail	0	6	9	18
Transportation and storage	0	6	15	11
Accommodation and food services	0	18	46	44
Information and communication	0	11	16	17
Financial and insurance activities	0	55	23	136
Professional and real estate	0	6	13	11
Administrative and support services	0	17	21	23
Public administration and defence	0	51	43	144
Education	0	12	32	33
Health and social work	0	9	16	9
Arts, entertainment and recreation	0	10	15	20
Other service activities	0	44	44	20

Source: GLA Economics calculations
Note: Job series have been expressed as index numbers, so results are comparable, and reflect growth trends, rather than relative sizes of populations

Table E.5 Comparisons of statistical properties of tests for backcasting self-employment sector jobs series, 1996-2015

	T-statistic significance		
	UK SEJ	**London SEJ**	**South East employees**
Primary and utilities	x	intercept	none
Manufacturing	x and intercept	x and intercept	x
Construction	x and intercept	x and intercept	intercept
Wholesale & retail	x	x	none
Transportation and storage	x	x and intercept	x
Accommodation and food services	none	intercept	x and intercept
Information and communication	x	x and intercept	x and intercept
Financial and insurance activities	x and intercept	x and intercept	x and intercept
Professional and real estate	x	x and intercept	x
Administrative and support services	x	x	none
Public administration and defence	x	intercept	x and intercept
Education	x	x and intercept	x and intercept
Health and social work	x	x and intercept	x
Arts, entertainment and recreation	x and intercept	x	x
Other service activities	x	x	none
	F-statistic significance		
	UK SEJ	**London SEJ**	**South East employees**
Primary and utilities	yes	no	no
Manufacturing	yes	yes	yes
Construction	yes	yes	no
Wholesale & retail	yes	yes	no
Transportation and storage	yes	yes	yes
Accommodation and food services	no	no	yes
Information and communication	yes	yes	yes
Financial and insurance activities	yes	yes	yes
Professional and real estate	yes	yes	yes
Administrative and support services	yes	yes	no
Public administration and defence	yes	no	yes
Education	yes	yes	yes
Health and social work	yes	yes	yes
Arts, entertainment and recreation	yes	yes	yes
Other service activities	yes	yes	no

Source: GLA Economics calculations

GLA Economics has backcast South East of England self-employment jobs for each sector as a constant share of UK self-employment jobs for that sector. This has the advantages of simplicity, consistency across sectors, and consistency with the decision on how to backcast the series for all self-employment jobs.

A comparison of backcast series from the options for this analysis, and with external forecasters is at Table E.6a and E.6b. Across the metrics and sectors there is a lot of variation between series, and with the preferred series for the South East of England.

Table E.6a Comparison of South East of England self-employment jobs series 1982-1996, GLA Economics options and back series of external forecasters, part 1

GLA Economics	CAGR					
	Tested options for South East SEJ back series			External forecaster back series		
	UK SEJ (chosen)	London SEJ	South East employees	Forecaster A	Forecaster B	Experian
Primary and utilities	3.1%	0.7%	4.1%	4.6%	-5.5%	1.1%
Manufacturing	3.1%	2.0%	-1.4%	3.2%	0.2%	2.6%
Construction	3.2%	1.0%	0.3%	3.6%	3.6%	3.0%
Wholesale	3.6%	0.1%	0.2%			3.4%
Retail	2.9%	0.5%	0.0%			0.8%
Transportation and storage	3.1%	1.0%	1.6%	3.8%	0.1%	3.7%
Accommodation and food services	3.1%	0.7%	-0.6%	2.7%	0.8%	0.6%
Information and communication	3.1%	2.0%	1.0%	3.7%	2.4%	8.2%
Financial and insurance activities	3.2%	1.4%	-5.9%	3.0%	-1.9%	-2.5%
Professional and real estate	3.1%	1.7%	4.2%	4.4%	1.1%	7.2%
Administrative and support services	3.2%	5.7%	2.4%	4.2%	3.0%	6.7%
Public administration and defence	3.0%	2.0%	n/a	2.9%	-0.5%	n/a
Education	3.2%	3.6%	n/a	4.0%	2.2%	1.0%
Health and social work	3.2%	2.2%	3.2%	3.5%	6.5%	1.9%
Arts, entertainment and recreation	3.1%	3.9%	1.6%	3.6%	7.4%	5.6%
Other service activities	3.2%	2.1%	0.6%	3.7%	-0.5%	5.6%
	Difference in CAGR					
	Tested options for South East SEJ back series			External forecaster back series		
	UK SEJ (chosen)	London SEJ	South East employees	Forecaster A	Forecaster B	Experian
Primary and utilities	0.0%	-2.4%	1.0%	1.5%	-8.7%	-2.0%
Manufacturing	0.0%	-1.1%	-4.5%	0.0%	-2.9%	-0.6%
Construction	0.0%	-2.2%	-2.9%	0.5%	0.4%	-0.1%
Wholesale	0.0%	-3.5%	-3.4%			-0.2%
Retail	0.0%	-2.4%	-2.9%			-2.1%
Transportation and storage	0.0%	-2.2%	-1.6%	0.6%	-3.0%	0.5%
Accommodation and food services	0.0%	-2.5%	-3.8%	-0.4%	-2.3%	-2.5%
Information and communication	0.0%	-1.2%	-2.1%	0.5%	-0.8%	5.1%
Financial and insurance activities	0.0%	-1.8%	-9.1%	-0.1%	-5.1%	-5.7%
Professional and real estate	0.0%	-1.5%	1.1%	1.2%	-2.1%	4.1%
Administrative and support services	0.0%	2.6%	-0.7%	1.1%	-0.2%	3.5%
Public administration and defence	0.0%	-0.9%	n/a	0.0%	-3.4%	n/a
Education	0.0%	0.5%	n/a	0.9%	-0.9%	-2.2%
Health and social work	0.0%	-0.9%	0.0%	0.3%	3.4%	-1.2%
Arts, entertainment and recreation	0.0%	0.7%	-1.5%	0.5%	4.3%	2.5%
Other service activities	0.0%	-1.0%	-2.5%	0.6%	-3.7%	2.5%
	Correlation coefficient					
	Tested options for South East SEJ back series			External forecaster back series		
	UK SEJ (chosen)	London SEJ	South East employees	Forecaster A	Forecaster B	Experian
Primary and utilities	1.00	0.82	0.95	0.98	-0.80	0.63
Manufacturing	1.00	0.76	-0.35	0.95	0.65	0.93
Construction	1.00	0.98	0.61	0.98	0.82	0.87
Wholesale	1.00	0.55	0.62			0.94
Retail	1.00	0.71	0.46			0.37
Transportation and storage	1.00	0.94	0.90	0.98	0.51	0.86
Accommodation and food services	1.00	-0.08	-0.88	0.85	0.70	0.27
Information and communication	1.00	0.96	0.91	0.98	0.95	0.98
Financial and insurance activities	1.00	0.85	-0.93	0.93	0.01	0.33
Professional and real estate	1.00	0.95	0.98	0.99	0.75	0.96
Administrative and support services	1.00	0.85	0.99	0.99	0.93	0.98
Public administration and defence	1.00	0.82	n/a	0.93	0.52	n/a
Education	1.00	0.96	n/a	0.99	-0.27	-0.03
Health and social work	1.00	0.96	0.99	0.96	0.83	0.42
Arts, entertainment and recreation	1.00	0.97	0.74	0.98	0.94	0.78
Other service activities	1.00	0.81	0.82	0.98	-0.17	0.81

Source: GLA Economics calculations
Notes: Experian self-employment series spliced to ONS values for self-employed jobs at 1996
Some estimates have been suppressed where it might disclose the identity of the external forecaster, and/or where estimates are not robust.

Table E.6b Comparison of South East of England self-employment jobs series 1982–1996, GLA Economics options and back series of external forecasters, part 2

	Cumulative sum of forecast differences					
	Tested options for South East SEJ			External forecaster back series		
	UK SEJ (chosen)	London SEJ	South East employees	Forecaster A	Forecaster B	Experian
Primary and utilities	0	11079	-8988	9965	157554	35186
Manufacturing	0	-68457	21688	-184561	49875	-11066
Construction	0	-59475	-144272	-75689	124226	113625
Wholesale	0	-27013	-54496			50475
Retail	0	52866	25224			216863
Transportation and storage	0	58374	19820	62517	72753	-38848
Accommodation and food services	0	-97320	626	-101858	81158	39936
Information and communication	0	11210	26093	31144	2891	-61009
Financial and insurance activities	0	39079	40458	63585	25513	31911
Professional and real estate	0	85285	-145215	-154712	-43995	-164904
Administrative and support services	0	-121110	-15588	26326	-29777	-55349
Public administration and defence	0	20007	n/a	19496	971338	n/a
Education	0	-16616	n/a	-17277	13253	-1439
Health and social work	0	68391	-33151	4779	-170721	-35418
Arts, entertainment and recreation	0	-76433	-105310	132936	-68779	-72905
Other service activities	0	-385350	-148187	133602	79134	-277991

	Mean absolute deviation					
	Tested options for South East SEJ			External forecaster back series		
	UK SEJ (chosen)	London SEJ	South East employees	Forecaster A	Forecaster B	Experian
Primary and utilities	0	1025	740	986	11833	2513
Manufacturing	0	5155	7353	13183	8239	2251
Construction	0	10485	13882	6243	18586	11864
Wholesale	0	3366	4311			3605
Retail	0	3949	2972			15490
Transportation and storage	0	4170	1618	4466	6010	3052
Accommodation and food services	0	6951	3184	7276	5910	4433
Information and communication	0	1044	1899	2225	689	4358
Financial and insurance activities	0	2791	4072	4542	1822	2279
Professional and real estate	0	6100	10372	11051	4860	11779
Administrative and support services	0	8651	1356	2066	2127	3992
Public administration and defence	0	1429	n/a	1393	69381	n/a
Education	0	1415	n/a	1325	5238	2141
Health and social work	0	4885	2368	1532	12194	3535
Arts, entertainment and recreation	0	5459	7522	9495	4913	5207
Other service activities	0	27525	10585	9543	8808	19857

	Mean percentage deviation (%)					
	Tested options for South East SEJ			External forecaster back series		
	UK SEJ (chosen)	London SEJ	South East employees	Forecaster A	Forecaster B	Experian
Primary and utilities	0	8	7	8	48	18
Manufacturing	0	14	17	47	17	6
Construction	0	9	13	6	14	8
Wholesale	0	15	20			13
Retail	0	12	9			33
Transportation and storage	0	16	7	16	21	17
Accommodation and food services	0	43	14	47	19	17
Information and communication	0	6	9	10	4	38
Financial and insurance activities	0	42	82	54	29	37
Professional and real estate	0	10	22	24	9	31
Administrative and support services	0	43	5	6	8	20
Public administration and defence	0	43	n/a	42	97	n/a
Education	0	9	n/a	9	29	12
Health and social work	0	12	7	4	60	11
Arts, entertainment and recreation	0	34	51	30	34	33
Other service activities	0	223	36	19	19	101

Source: GLA Economics calculations
Notes: Experian self-employment series spliced to ONS values for self-employed jobs at 1996
Some estimates have been suppressed where it might disclose the identity of the external forecaster, and/or where estimates are not robust.

E.7. Output data definitions

This section discusses the measures of output, and the available ONS series to provide a backcast series.

There are three ways to measure national output:

- Income-based approach which measures the total income generated by the production of goods and services within the economy;
- Production-based approach which measures the sum of the value added created through the production of goods and services within the economy (our production or output as an economy); and,
- Expenditure-based approach which measures total expenditure on all finished goods and services produced within the economy.

At a UK-level the Office for National Statistics combines the three estimates into a single measure. Conceptually they are equivalent once you take account of trade effects with other countries as measured by the balance of payments.

Statistics for regional output use an income measure, and this is a National Statistic. ONS has also developed a production measure, which currently is an experimental statistic. There is no regional expenditure measure as it is not straightforward to attribute to residence or location. It would need to reflect that commuters and residents might spend money outside the region, and tourists and visitors would spend money in the region.

ONS provides output statistics measured by GVA or gross domestic product (GDP). The link between GVA and GDP is[40]:

- GVA (at current basic prices; available by industry only)
- plus taxes on products (available at whole economy level only)
- less subsidies on products (available at whole economy level only)
- equals GDP (at current market prices; available at whole economy level only)

Two ONS data series have been used to support this analysis:

Government Office Region GVA estimates 1997-2015
- This is an income-based measure of output

Standard Statistical Region GDP at factor cost, 1968-1970,1971-1996[41]
- These estimates can be used as a proxy for current regional Gross Value Added (GVA) estimates, but are not consistent because:
  - They were compiled as GDP estimates rather than GVA estimates.
  - They use industrial breakdowns as defined in Standard Industrial Classification (SIC) 1980 and SIC 1992, while current estimates use SIC 2007.
  - The accounting methodology has changed from the European System of Accounts (ESA) 1979 to ESA 2010.[42]

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[40] See [ARCHIVED CONTENT] Regional Accounts - ONS
[41] See Historical Regional GDP 1968 to 1970 and 1971 to 1996 - Office for National Statistics
[42] See European system of accounts - ESA 2010 - Product - Eurostat

The productivity back series for the employment projections uses a real output series, that is a series where output for all year is measured in the prices of one year, and so excludes the effects of inflation.

The base measure of output used by GLA Economics is nominal GVA as this is the main current ONS series. ONS regional price deflators, which convert nominal GVA to constant prices, are an experimental series, and are only available to 1997. This analysis for the South East of England converts sub-regional GVA nominal GVA estimates for 1997 onwards using the methodology that GLA Economics uses to derive real GVA estimates for the London economy[43].

For the period 1981-96 the only price deflator which is available back is for the UK[44], and so this is what has been applied to sub-regions of the Wider South East to constrain GVA estimates for the East and South East of England from backcasting real GVA estimates for 1997 to 2015.

E.8. Backcasting GVA to 1981

E.8.1. Available data and geographical coverage
The approach adopted has been to splice the GVA series back to 1997 with the GDP series up to 1996. The GDP series is only available for SSRs, which do not align with GORs. The GVA data is available for SSRs and GORs. The NUTS1[45] regional geography is GORs, while it is possible to produce GVA estimates for SSRs from NUTS2 sub-regional geographies.

The East of England GOR consists of:

- East Anglia
- Bedfordshire and Hertfordshire
- Essex

Outside London there were two SSRs in the wider south east:

- East Anglia
- Rest of South East, consisting of the South East GOR, Bedfordshire and Hertfordshire, and Essex

That is the Rest of South East SSR extends beyond the South East GOR, and covers part of the East of England in a way which aligns with current geographies, see Map 1 above.

E.8.2. Development of a GDP back series
The development of the projections requires a real GVA series back to 1981 for the South East of England. In parallel, the development of the East labour market projections also requires the development of a real GVA series for that region. There is a GDP series for these two areas combined, which is to combine the GDP estimates for East Anglia and the Rest of the South East. This can provide a consistency check, and constraint, on the combined GVA estimates for the GORs, but first it requires the GDP estimates to be placed on a consistent basis. This section explains how this has been done:

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[43] See Modelling real quarterly GVA data for London | London City Hall
[44] See UK Economic Accounts time series dataset – Office for National Statistics
[45] For definitions see Eurostat – Office for National Statistics

As GVA data starts from 1997, and the last year of GDP data is 1996, there is no year for which there is both GVA and GDP data, and so there is a discontinuity in the series. The recorded share of UK GDP of the Wider South East outside London in 1996 is notably higher than the comparable share of UK GVA in 1997. This is most likely attributable to different means of measuring output as more taxes are likely to be paid in wealthier parts of the country such as London, and spent elsewhere. Since the figures are not comparable, and in the absence of other data the shares of output for East Anglia and the Rest of the South East in 1996 have been maintained at their 1997 values.

Year-on-year changes in share of UK output for both these SSR are the same as for the published GDP data. This is applied to UK GVA data to estimate GVA for East Anglia and the Rest of the South East for 1981-1996.

E.8.3. Development of a GVA back series

Two options for comparison have been considered to splice SSR and South East of England GOR data:

- East Anglia SSR
- Rest of South East SSR

There are a set of statistical comparisons for these options at Table E.7. Across a range of metrics both options are very similar to the series for the South East of England.

Table E.7 Comparisons of statistical properties of options and tests for backcasting South East of England GVA series

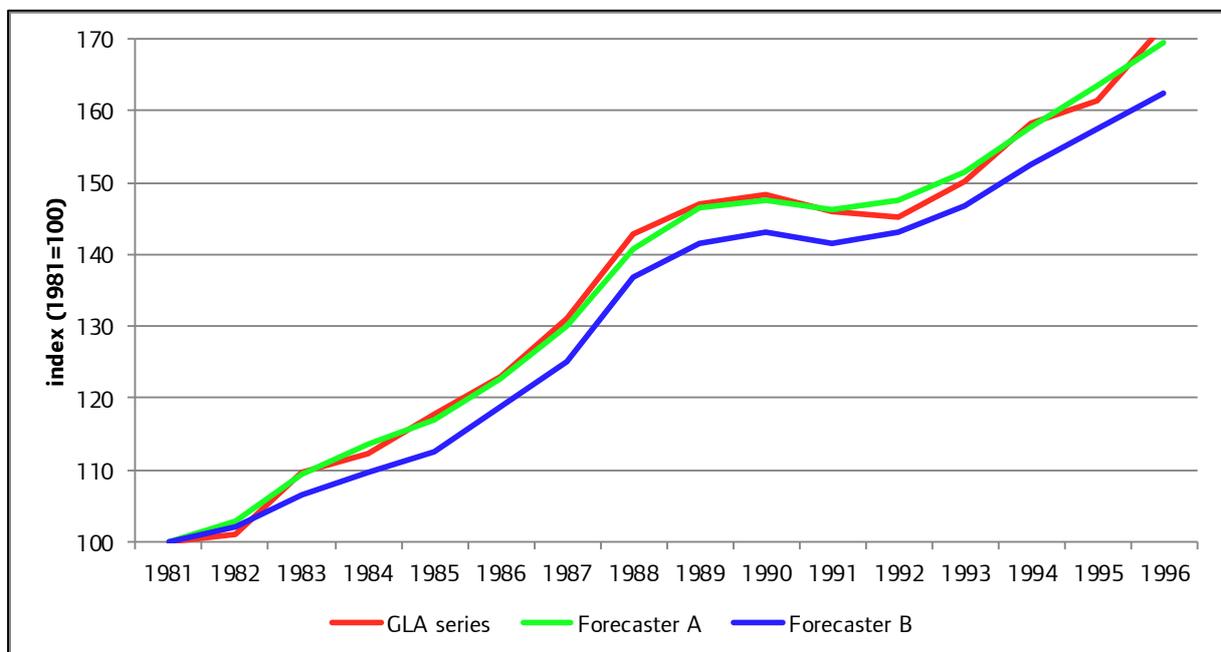|	South East of England	East Anglia SSR	Rest of South East SSR
CAGR	3.9%	3.9%	3.9%
Difference in CAGR	0.0%	0.0%	-0.1%
Correlation coefficient	1.000	0.997	1.000
Cumulative sum of forecast differences	0	-28	-11
Mean absolute deviation	0	2	1
Mean percentage difference (%)	0	2	0
regression statistical significance			
x-coefficient		yes	yes
intercept term		no	yes
F-statistic		yes	yes

Source: GLA Economics calculations

GLA Economics has backcast South East of England GVA using the Rest of South East SSR as the comparator geographic area. The statistical fit is marginally better than for East Anglia, and the South East of England GOR lies wholly within the Rest of South East SSR, which seems more appropriate for a comparator.

The backcast South East of England GVA estimates for 1981-1996 have been derived through a series of steps:

- Produce unconstrained estimates through linear regression for each year
- Add for each year to unconstrained estimates for the East of England, and set out in the East of England labour market projections paper, which provides a GVA back series for the wider south east outside London
- Estimates for GVA for the East of England and the South East of England for each year are constrained to estimates for GVA for the wider south east outside London derived from the GDP series, as set out section E.8.2

A comparison of backcast series from the option in this analysis, and with external forecasters is at Figure E.3 and Table E.8. The GLA series is closer to the trend of Forecaster A (Figure E.3), although there is more of a mixed picture for the descriptive statistics (Table E.8).

Figure E.3 Comparison of South East of England GVA series 1981-1996, GLA Economics series and back series of external forecasters

Source: GLA Economics calculations

Table E.8 Comparison of South East of England GVA series 1981-1996, GLA Economics series and back series of external forecasters

	GLA series	Forecaster A	Forecaster B
CAGR	3.7%	3.6%	3.3%
Difference in CAGR	0.0%	-0.1%	-0.4%
Correlation coefficient	1.000	0.998	0.996
Cumulative sum of forecast differences	0	-257569	-178267
Mean absolute deviation	0	16098	11142
Mean percentage difference (%)	0	14	9

Source: GLA Economics calculations

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