

March 2015

UK Economic Outlook

The impact of lower oil prices on the UK economy

New job creation in the UK: which regions will benefit most from the digital revolution?



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Highlights and key messages for business and public policy

- The UK economy has been recovering at a relatively strong rate since early 2013, although there were signs of a slight slowdown in growth in late 2014 due to problems in the Eurozone and other geopolitical uncertainties.
- In our main scenario we expect GDP growth to average around 2.5% in 2015, supported by recent oil price falls, before easing slightly to around 2.3% in 2016.
- We judge that risks to UK growth are weighted somewhat to the downside in the short term due to international risks, but there are also upside possibilities in the medium term if the global economic environment improves.
- We expect the services sector to remain the main engine of UK growth for both output and employment. Manufacturing and construction growth have slowed recently, but should remain positive contributors to overall UK growth in 2015-16.

Lower oil prices are positive for the UK economy

- The sharp fall in oil prices since mid-2014 should boost most sectors of the economy except for those directly involved in oil and gas production.
- In our central scenario, where oil prices rise gradually to around \$73 per barrel in 2020, total UK employment could be around 37,000 higher in 2020 than in a baseline scenario where oil prices remained at their mid-2014 levels of around \$108 per barrel through to 2020.
- Lower oil prices should also benefit consumers significantly in the short term, as well as boosting government revenues and narrowing the trade deficit slightly.

Key projections

	2015	2016
Real GDP growth	2.5%	2.3%
Inflation (CPI)	0.3%	1.8%

Source: PwC main scenario projections

Low inflation in the short term may not prevent interest rate rises from late 2015

- Consumer price inflation is likely to be close to zero on average in 2015 due to lower global energy and food prices, but could return to target by the end of 2016.
- We expect the MPC to keep interest rates on hold in the short term, but then to increase them gradually from late 2015 or early 2016 onwards, returning to around 3.5-4% by 2020. Businesses and households should start to prepare for this upward trend now.

London continues to lead the recovery, but growth has diffused to other regions

- London and the South East are continuing to lead the recovery, as has been the pattern for many years, but other UK regions should also register positive real growth of around 1.7-2.5% in 2015.
- Detailed analysis in this report shows that London has been a key source of new job creation associated with the digital revolution of the past 25 years. But the benefits of this have started to diffuse to other regions over the past ten years and we expect this to continue.

- We think greater regional balance would be good for the long-term future of the UK economy, but this should not be at the expense of weakening the London economy. London needs increased investment in affordable housing and transport infrastructure to support potential continued strong jobs growth over the next decade.
- There should also be an emphasis on building up successful manufacturing and service sector clusters outside London and the South East, which requires long-term investment in transport infrastructure, skills and knowledge hubs linked to top regional universities.

1 – Summary

Recent developments

The UK economy grew by 2.6% in 2014 as a whole, which was the fastest rate seen since 2007 and the strongest growth rate in the G7.

However, UK quarter-on-quarter GDP growth slowed somewhat to 0.5% in the fourth quarter of 2014, which appears to reflect the drag from sluggish growth in the Eurozone as well as wider global geopolitical risks related to the situation in Russia/Ukraine and the Middle East in particular. But lower global oil prices have been a positive factor from the perspective of UK consumers.

UK growth has been driven primarily by services over the past five years, but manufacturing and construction have also been on an upward trend since early 2013 despite some slowdown in late 2014.

The slowdown in the Eurozone has been partly offset by stronger growth in the US since the second quarter of 2014, but more generally international risks have increased over the past nine months. As such, UK growth remains heavily dependent on domestic demand.

UK employment has continued to rise strongly, which has supported consumer spending growth despite relatively subdued rates of average real earnings growth until recent months. Rising house prices have also supported consumer confidence and spending, but have moderated since mid-2014.

Business investment had been showing signs of a stronger recovery in recent years, though this fell back somewhat in late 2014 according to the latest preliminary official estimates. Public spending cuts have slowed down over the past year, but will remain a drag on growth for many years to come and could accelerate again after the general election.

The rate of consumer price inflation (CPI) has fallen sharply over the past year to record lows as import price inflation has dropped due to global energy and food price declines.

Future prospects

As shown in Table 1.1, our main scenario is for UK GDP growth to average around 2.5% in 2015 and around 2.3% in 2016. This is similar to the latest consensus and OBR forecasts.

Consumer spending growth is projected to be broadly similar to GDP growth, with a boost from lower oil prices this year but some moderation in growth in 2016.

We expect continued investment growth in 2015, but at a slower rate than in 2014 as business confidence could be affected by increased international risks and possibly also temporary uncertainty around the general election outcome.

Net exports have been erratic, but we do not expect them to make a significant positive contribution to growth in 2015 and 2016 given ongoing problems in the Eurozone in particular. UK growth will therefore remain heavily dependent on domestic demand.

As always there are many uncertainties surrounding our growth projections, as illustrated by the alternative scenarios in Figure 1.1. There are still considerable

downside risks relating to trends in the Eurozone and emerging markets (including Ukraine and the Middle East), and these have increased since mid-2014. But there are also upside possibilities if these problems can be avoided and a virtuous circle of rising confidence and spending can be established as in past economic recoveries.

Inflation will remain very low this year, but could rebound to close to target in 2016 if past falls in global energy and food prices do not continue. There could be upside risks to this inflation outlook in the longer term if domestic wages start to recover without a corresponding rise in productivity.

We do not expect any immediate rise in official UK interest rates, but a gradual upward trend seems likely to begin in late 2015 or early 2016. In the long term, however, we would still expect official rates to return very gradually to a more normal level of around 3.5-4% by 2020.

Higher interest rates will help savers and reduce pension fund deficits, but borrowers (including businesses and the government) might gain from locking in funding now for long term investments such as infrastructure and housing. Households need to bear in mind likely future interest rate rises in any decisions on mortgages or other longer term loans.

Table 1.1 – Summary of UK economic growth prospects

Indicator (% change on previous year)	OBR forecasts (December 2014)		Independent forecasts (February 2015)		PwC Main scenario (March 2015)	
	2015	2016	2015	2016	2015	2016
GDP	2.4	2.2	2.6	2.3	2.5	2.3
Consumer spending	2.8	2.2	2.9	2.4	2.6	2.3

Source: Office for Budget Responsibility (December 2014), HM Treasury survey of independent forecasts (average values in February 2015 survey) and latest PwC main scenario.

Impact of lower oil prices on the UK economy

As discussed in detail in Section 3 of this report, we think that the fall in the oil price since mid-2014 should have a significant positive impact on the UK by increasing overall economic activity as the cost of production decreases for businesses, especially for those that are heavily dependent on oil inputs.

Although the oil and gas extraction sector is negatively affected by the reduction in the oil price, sectors such as agriculture, air transport, coke and refined petroleum manufacturing, and oil-intensive manufacturing sectors will benefit as the price of a key input falls.

Our modelling implies that water transport and other services sectors will enjoy a smaller positive impact. However, oil-intensive sectors are likely to benefit from the reallocation of capital and resources at the expense of less oil-intensive sectors.

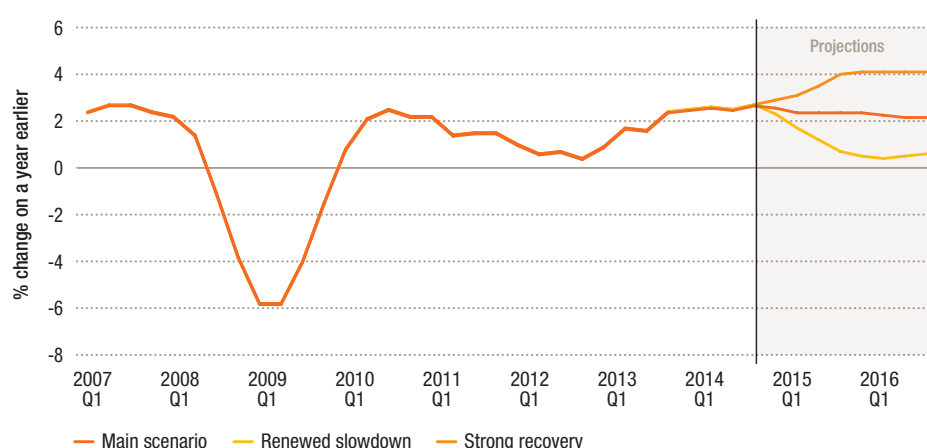
Future oil price trends remain highly uncertain, so we have looked at three alternative scenarios. In a case where the reduction in the oil price is persistent, the size of the UK economy increases by around 1% on average relative to the baseline between 2015 and 2020. Employment also increases by around 90,000 by 2020 in this case (Scenario 1 in Table 1.2).

In contrast, the impacts are much smaller where the fall in the oil price is wholly or partially temporary: in these scenarios the average impact on the level of GDP is 0.2-0.5%, with employment effects in 2020 of around 3,000 to 37,000 depending on how far and fast oil prices rebound. The central case (Scenario 2) where output is 0.5% higher and employment in 2020 around 37,000 higher would be most consistent with our main scenario for the UK economy, but the other scenarios shown in Table 1.2 are also quite plausible outcomes.

Real household incomes also rise due to lower oil prices, which increases consumer spending. As a result of growing economic activity, we project that government tax revenues should also rise as the tax take from corporate and personal income taxes increases by more than the loss of North Sea oil and gas revenues.

In summary, lower oil prices should be positive for most sectors of the UK economy, households and the government. But the scale of these benefits remains highly uncertain depending on how oil prices evolve from here.

Figure 1.1: Alternative UK GDP growth scenarios



Source: ONS, PwC scenarios

Table 1.2: Increase in total UK employment relative to baseline: 2016 and 2020

Oil price scenarios (\$ per barrel)	2016	2020
Scenario 1 (settling at \$50)	121,000	91,000
Scenario 2 (rising to \$73 by 2020)	53,000	37,000
Scenario 3 (rising back to \$108 by 2020)	11,000	3,000

Source: PwC analysis (the effects shown are relative to employment levels in a baseline case where oil prices remained at their mid-2014 level of around \$108 per barrel through to 2020).

Which UK regions will benefit most from digital job creation?

The digital revolution has both created and displaced many types of jobs since 1990. In a special article in Section 4 of this report by Dr Carl Benedikt Frey of Oxford University and John Hawksorth of PwC, we focus on the new types of jobs created since 1990 and assess how this has affected total national and regional employment in the UK since 2004. We highlight the key role of London as an incubator for the digital revolution, but also find some signs of catch up in other regions such as the North, Wales and Northern Ireland.

We examined new job titles that emerged only after 1990 and found that 5.5% of the UK workforce had shifted into these new types of jobs by 2004. But by 2014 this proportion had risen only slightly further to around 6%. Eight of the ten occupational categories where these new job titles arose were related to computers, so this can largely be linked to the digital revolution.

London has been the greatest motor for the creation of new types of jobs, outperforming the rest of the UK economy: for example, new types of jobs in Central London increased from 8.6% to 9.8% of total employment between 2004 and 2014.

But we also find some evidence of regional convergence over the past decade. While London continues to lead in terms of the proportion of workers in new types of jobs, regions like Yorkshire, Tyne & Wear, Wales and Northern Ireland with low initial employment shares in new types of jobs in 2004 experienced higher growth rates of these new job types on average between 2004 and 2014.

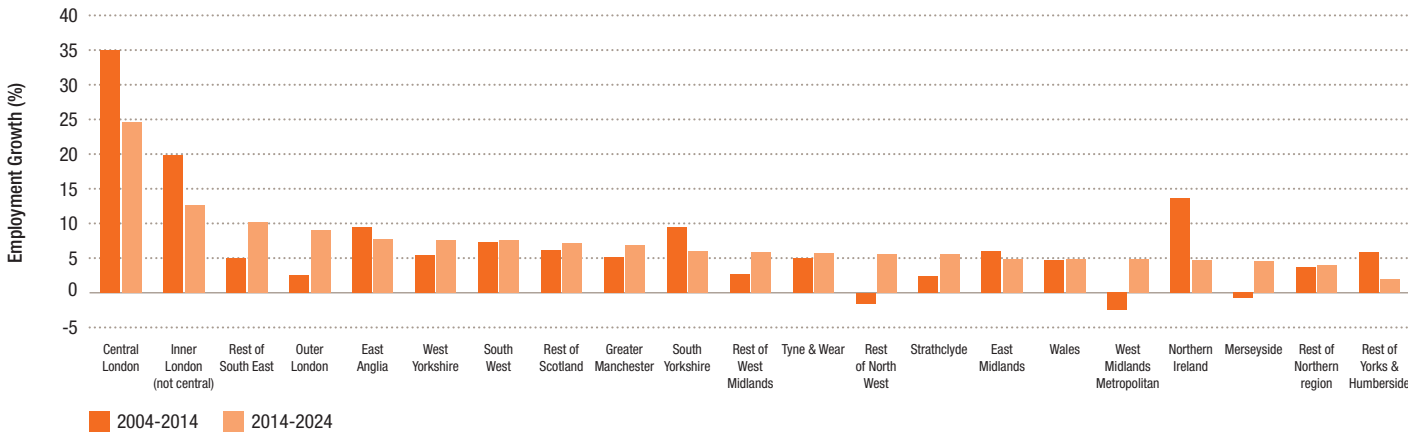
Our findings suggest that new types of jobs created since 1990 (linked mainly but not only to the digital revolution) initially appeared in areas like London where entrepreneurs, innovative firms and skilled workers were concentrated and then gradually diffused to other regions. These other regions will continue to catch up unless London’s pace of new job creation is higher than the rate of regional diffusion.

Projecting patterns in regional employment growth over the next decade, we find that total employment in Central London could grow by around 25% between 2014 and 2024, but this would be down from around 35% total employment growth over the past ten years (see Figure 1.2).

By contrast, employment growth rates over the next decade in regions like West Yorkshire, Greater Manchester, the West Midlands, Scotland and the rest of the South East are projected to see some acceleration in job creation relative to the past decade as the digital revolution continues to diffuse.

Future UK and London governments need to make sure that the city’s growth potential is not constrained by the supply of housing and transport infrastructure. But it also needs to support the diffusion of digital job creation to other UK regions by boosting transport links outside London, supporting leading regional universities, and building skills, which we find to be a key driver of economic success for cities.

Figure 1.2: Projected total employment growth in UK regions, 2014-2024, as compared to the past decade



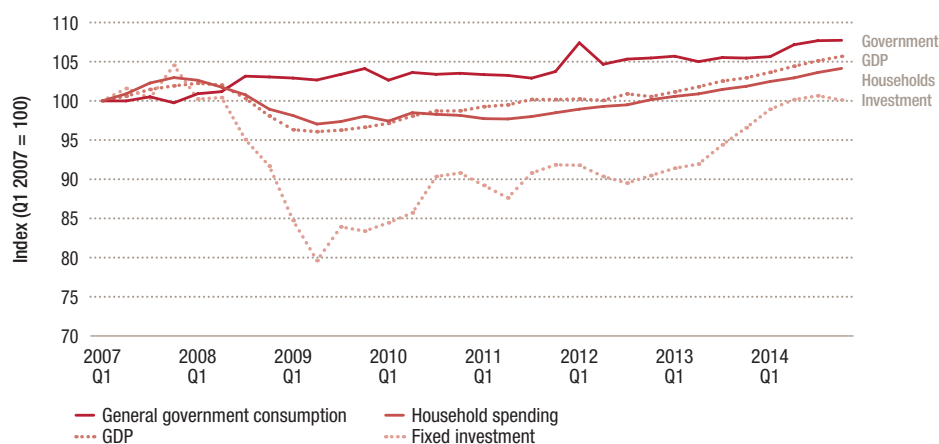
Source: ONS Labour Force Survey; calculations by Carl Frey

2 – UK Economic prospects

Key points

- The UK economy expanded by 2.6% in 2014, its strongest growth rate since 2007. However, there was some loss of momentum in the final quarter of the year.
- In our main scenario, we expect the UK economy to grow by around 2.5% this year, moderating slightly to around 2.3% in 2016.
- The services sector remains the primary driver of UK growth as output in manufacturing and construction are still well below their pre-crisis level and lost some momentum in the second half of 2014. However, we expect all major sectors to show reasonable growth in 2015-16.
- London and the South East are expected to maintain their positions as the two fastest growing regions in the UK this year, but other regions should also see positive growth.
- The UK recovery is still exposed to downside risks emanating from the Eurozone and an escalation of geopolitical unrest in Russia/Ukraine and/or the Middle East. However, there are also upside possibilities from a larger than expected boost to household spending from lower oil prices, faster falls in the unemployment rate and stronger real wage growth.
- The falling oil price has pushed inflation close to zero recently, but it is likely to rebound to close to target by late 2016. The potential medium-term upward pressures on inflation that could emerge as the recovery continues may lead to a gradual increase in the official interest rate from late 2015 onwards, although the timing of the first UK rate rise remains highly uncertain.

Figure 2.1: GDP and key components of domestic demand



Source: ONS

- Public borrowing now looks likely to come in at around £90 billion this fiscal year, close to OBR projections. We expect a broadly neutral Budget on 18th March, with any 'giveaways' largely matched by 'takeaways'.

Introduction

In this section of the report we describe recent developments in the UK economy and review future prospects. The discussion covers:

- 2.1 Recent developments and the present situation
- 2.2 Economic growth prospects: national, sectoral and regional
- 2.3 Outlook for inflation and real earnings growth
- 2.4 Monetary and fiscal policy options
- 2.5 Summary and conclusions

2.1 – Recent developments and the present situation

UK GDP growth of 2.6% in 2014 was the fastest since 2007 and the strongest in the G7. But the pace of quarter-on-quarter growth eased to 0.5% in the final quarter of 2014, reflecting slower growth in the Eurozone and other geopolitical uncertainties.

As shown in Figure 2.1, the level of GDP has been on an upward trajectory for the last few years, largely tracking consumer spending growth. Although still around 4% below its pre-crisis peak, fixed investment has also picked up strongly in recent years according to the latest official estimates (though investment dipped again in Q4 2014 relative to the previous quarter). Government spending held up better in the recession, but has grown more slowly recently as the Treasury has sought to bring the budget deficit down.

Services continue to lead the recovery

As shown in Figure 2.2, the services sector continues to outperform manufacturing and construction, and remains the main driver of economic growth. Output levels in the manufacturing and construction sectors were still well below their pre-crisis peaks by around 5% and 8% respectively in Q4 2014.

Despite the upward trend in output levels in the construction sector in the first three quarters of 2014, there was a sharp downturn in the last quarter of the year owing in large part to a drop in repair and maintenance work, which experienced the largest quarter-on-quarter fall since Q4 2009. For the year as a whole, however, the picture was more promising with an annual growth

Figure 2.2: Sectoral output and GDP trends



Source: ONS

rate of 7.3% in 2014. Despite the disappointing fourth quarter data, the January construction PMI of 59.1 indicates that growth momentum may have returned in early 2015, although this is still lower than the average of 61.8 seen in 2014 as a whole.

Manufacturing output grew by 2.7% on average in 2014, which was the highest pace of growth since 2010. Manufacturing output growth almost stalled in Q4 2014, however, due in part to the drag on exports from the weakness of demand from the Eurozone. Lower oil prices, feeding in through a decline in input costs, should boost manufacturing this year, however, as discussed in more detail in Section 3 below.

The message from the official data is largely confirmed by the latest Markit/CIPS Purchasing Managers' Indices (PMIs) for services and manufacturing (as shown in Figure 2.3). The services sector PMI in early 2015 signalled that the sector was still growing relatively strongly despite some slowdown over

the past year. There was a sharp fall in the pace of growth in the manufacturing sector in mid-2014, due in part to weakness in demand from the Eurozone. The manufacturing PMI has been more stable in recent months, and remained in positive territory at around 54 in February 2015. But it is still the services sector that is leading the UK recovery in early 2015 according to these PMI indices.

The services sector continues to outperform manufacturing and construction, and remains the main driver of economic growth.

Recovery still driven by jobs not productivity

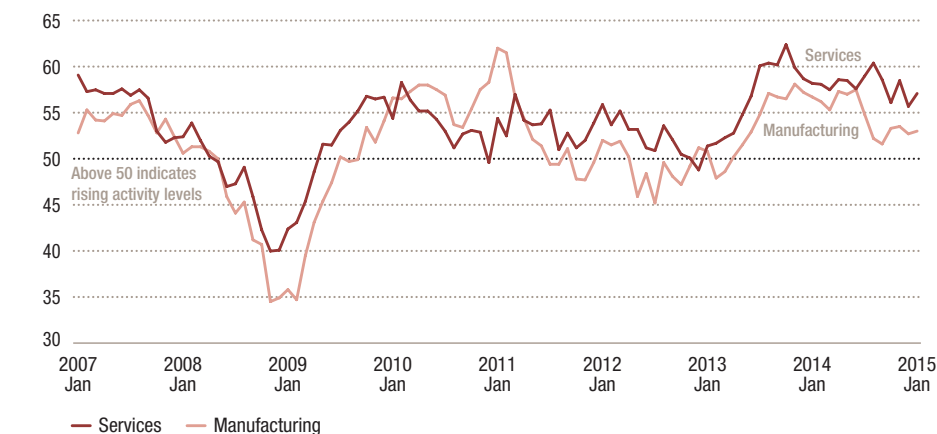
A continuing notable trend in the UK economy is the robust increase in employment, which has surpassed its pre-crisis levels, but productivity remains subdued as shown in Figure 2.4. Employment growth has been particularly strong since early 2013 and continued its upward momentum throughout 2014. The unemployment rate reported for the last quarter of 2014 was 5.7%, down from 7.2% a year earlier.

One of the biggest uncertainties for the future of UK recovery is whether and when productivity will pick up. Given that there is now less spare capacity in the economy (only around 0.5% of GDP according to latest Bank of England estimates), stronger productivity growth will be critical in enabling wages to recover without sparking inflationary pressures in the medium term.

The ‘productivity puzzle’ of recent years has persisted despite revised data published last autumn showing stronger investment growth than previously thought during the recovery, so reducing the significance of this factor in explaining why UK productivity has remained so low. It may be, however, that it will take time for this investment to push up productivity growth, at least as measured by the national accounts.

The robust labour market performance in the last quarter of 2014 is good news, but signs of labour market tightening have started to emerge as vacancies have risen above their 2008 peak and business surveys are indicating rising skills shortages, for example in the construction sector. There has been some

Figure 2.3: Purchasing Managers’ Indices of business activity



Source: Markit/CIPS

Figure 2.4: Employment is rising strongly but productivity has been broadly flat



Source: ONS

increase in average earnings growth with regular pay growing by 1.7% in the last quarter of 2014 compared to a year earlier, significantly faster than the growth rate of consumer prices for the first time in many years. Future prospects for real earnings growth are considered further in Section 2.3 below.

Housing market has cooled

House prices ended 2014 around 10% higher than at the start of the year, which was the strongest annual average performance since 2007. But there were clear signs of the pace of house price increases easing later in the year.

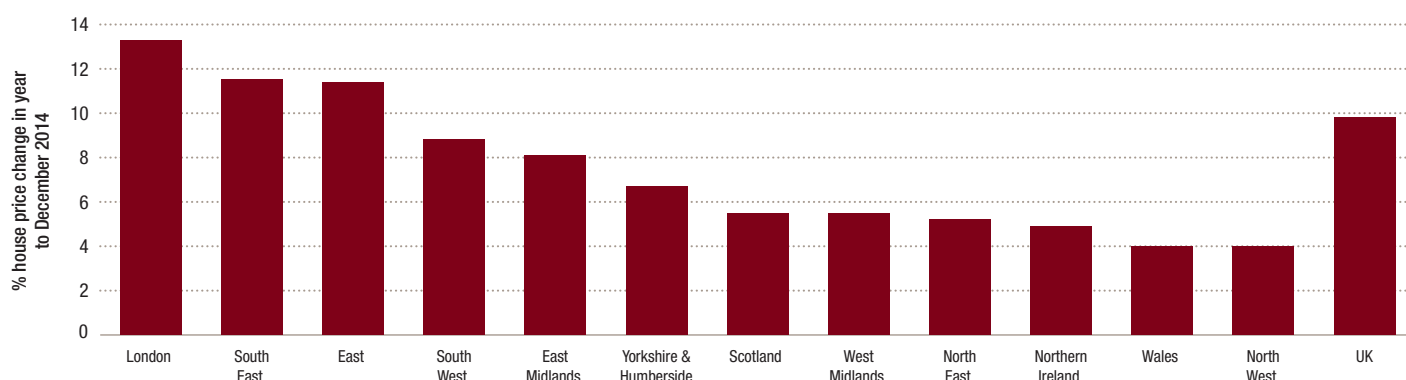
Figure 2.5 shows nominal house prices rises over the year to December 2014 by region based on official ONS data.

The London housing market experienced average price growth of 17.4% in 2014, the fastest growth rate since 2000, though this rate of increase had moderated to 13.3% by the end of 2014 as Figure 2.5 shows. The average London home now costs around £500,000 according to the ONS, although this is down somewhat from its peak in mid-2014. Excluding London and the South East, house prices

increased by 7.4% in the 12 months to December 2014.

We think average house prices across the whole of the UK will grow at an average rate of around 6-8% this year, which would involve some further moderation in the pace of growth, particularly in London¹.

Figure 2.5: House price rises by region

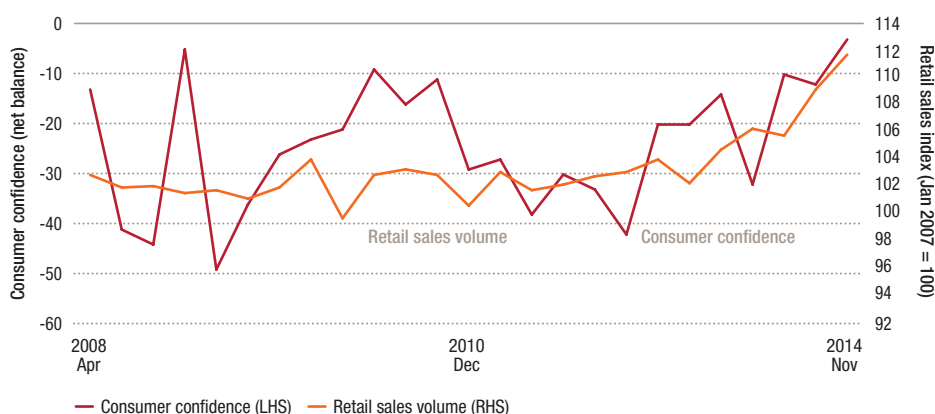


Source: ONS

Consumer spending remains relatively buoyant

Figure 2.6 shows the evolution of consumer confidence and retail sales. During the financial crisis and subsequent downturn, the two did not really move in a similar pattern. Since early 2014, however, there has been a pick-up in both measures as the recovery in the UK has strengthened and lower oil and food prices have boosted real household spending power.

Figure 2.6: Consumer confidence and retail sales



Sources: PwC Consumer survey, ONS,

¹ We plan to analyse house price prospects in more detail in the July 2015 edition of this report.

Mixed trends in stock markets

Equity market indices in the US, UK and Eurozone picked up towards the end of 2014 and in early 2015 after falling back in September last year (see Figure 2.7). Despite their volatile nature in the short term, equity markets in the US and Eurozone had a reasonably strong year in 2014 as a whole, but the UK market was less strong². This could reflect the global composition of the FTSE, which makes it relatively exposed to the rise in geopolitical risks during seen during 2014. Nonetheless, equity markets remain broadly supportive of investment growth, particularly in the US.

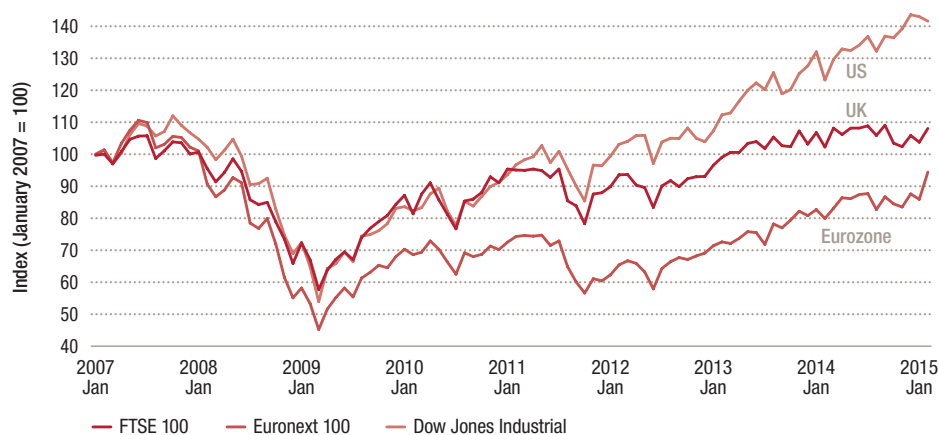
2.2 Economic growth prospects: national, sectoral and regional

We are projecting GDP growth of around 2.5% in 2015, very similar to 2014, falling slightly to around 2.3% in 2016 (see Table 2.1).

Our overall GDP growth projections are largely unchanged from the previous edition of this report in November 2014, with the boost from lower oil prices offset by increased risks relating to the Eurozone and wider geopolitical risks. We have, however, revised our estimates for the different expenditure components and inflation in line with recent data releases.

We expect consumer spending growth to remain relatively robust at around 2.6% in 2015, but with some moderation in growth in 2016 as the household savings rate stabilises and spending growth becomes more dependent on real income growth.

Figure 2.7: Equity market indices



Source: Thomson Reuters Datastream

Table 2.1 – PwC main scenario for UK growth and inflation

(% real annual growth unless stated otherwise)	2014	2015p	2016p
GDP	2.6%	2.5%	2.3%
Consumer spending	2.1%	2.6%	2.3%
Government consumption	1.5%	1.1%	0.6%
Fixed investment	6.8%	2.9%	4.8%
Domestic demand	2.9%	2.2%	2.4%
Net exports (% of GDP)	-0.5%	0.2%	-0.2%
CPI inflation (%: annual average)	1.5%	0.3%	1.8%

Source: ONS for 2014, PwC main scenario projections for 2015-16

² Although the FTSE performed better in February 2015.

We expect reasonably robust growth in business investment this year³ and next owing to the benefits of lower oil prices and steady domestic demand growth, though the election may lead to a temporary period of uncertainty that could slow investment growth during the first half of 2015. Total investment remains below its pre-crisis peak, however, so there is still room to grow to make up for past relative weakness (see Figure 2.1). With interest rates still at record low levels, businesses are expected to continue to take advantage of this to boost their investment levels.

Government consumption growth is projected to remain modest as the new government, of whatever complexion, continues to bear down on the budget deficit in 2015 and 2016.

Net exports are expected to make a broadly neutral contribution to GDP growth on average in 2015 and 2016 as the Eurozone remains relatively weak and global growth picks up only slowly in our main scenario (though the US should be a bright spot here, which should boost UK services exports in particular).

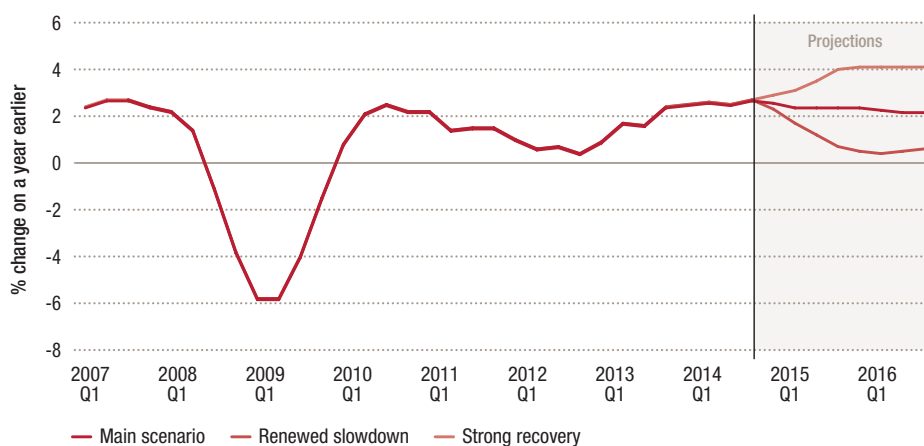
A comparison of Tables 2.1 and 2.2 shows that our latest GDP projections are slightly more optimistic than those of the OBR from December, but similar to the more timely estimates from the average of the independent forecasts surveyed by the Treasury in February.

Table 2.2 – Official and independent forecasts

(% real YoY growth unless stated otherwise)	Latest estimates	OBR forecasts (December 2014)		Average independent forecasts (February 2015)	
	2014	2015	2016	2015	2016
GDP	2.6%	2.4%	2.2%	2.6%	2.3%
Manufacturing output	2.7%	N/A	N/A	1.7%	1.8%
Consumer spending	2.1%	2.8%	2.2%	2.9%	2.4%
Fixed investment	6.8%	8.4%	5.9%	5.3%	5.0%
Government consumption	1.5%	-0.4%	-0.6%	0.8%	-0.1%
Domestic demand	2.9%	2.9%	2.2%	2.7%	2.3%
Exports	0.4%	2.4%	4.7%	2.9%	4.3%
Imports	1.8%	3.9%	4.7%	3.0%	4.1%
Current account (£bn)	-74	-64.6	-55.2	-82.5	-78.3
Unemployment claimant count (Q4, m)	0.8	0.84	0.83	0.8	0.8

Source: ONS for 2014, OBR Economic and Fiscal Outlook (December 2014), HM Treasury Forecasts for the UK economy: a comparison of independent forecasts (February 2015)

Figure 2.8: Alternative UK GDP growth scenarios



Source: ONS, PwC scenarios

³ The projected average annual growth rate of investment in 2015 is dampened by base effects following an apparent fall in Q4 2014, although this was only a preliminary estimate that could well be revised later.

Alternative growth scenarios

Uncertainty remains a key theme when considering future prospects for the economy and, to account for this, we have considered two alternative UK growth scenarios in addition to our main scenario, as shown in Figure 2.8:

- Our **‘strong recovery’ scenario** projects growth accelerating to around 4% in 2016. This relatively optimistic scenario assumes a much quicker recovery in the Eurozone and global economies than in our main scenario, boosting consumer and business confidence in the UK. This in turn would result in businesses undertaking greater investment activity and an increase in consumer spending, as well as higher demand for UK goods abroad.

- Our **‘renewed slowdown’ scenario**, by contrast, sees UK growth slowing down sharply to only around 0.5% in 2016. This is based on the assumption of adverse shocks emanating from a revived crisis in the Eurozone, such as the possibility of Greece exiting the euro, a significantly weaker economic outlook in some Asian markets such as China, as well as further unrest in Russia/Ukraine and the Middle East. These events would have negative implications for UK business, damaging confidence which could lead to cutbacks in investment and employment, thereby also depressing consumer spending.

We do not believe that these alternative scenarios are the most likely outcomes, but they are certainly well within the bounds of plausibility. Businesses

should ensure they have contingency plans in place to deal with the possibility of these kinds of events.

In the short term, risks to growth remain somewhat tilted to the downside given international uncertainties, but they appear more balanced in the medium term if these short term risks do not materialise, particularly if oil prices remain relatively low (as discussed further in Section 3 below).

Sectoral prospects

The sector dashboard in Table 2.3 shows the actual growth rates for 2014, alongside our projected growth rates for 2015 and 2016⁴, for five of the main sectors within the UK economy. The table also includes a summary of the key issues affecting each sector.

Table 2.3 – UK sector dashboard

Sector and GVA share	Growth			Key issues/trends
	2014	2015p	2016p	
Manufacturing (10%)	2.7%	2.5%	2.9%	The manufacturing sector started the year on a reasonably high note with a PMI of 53 in January. Oil price falls should provide a boost for the sector in 2015. The ongoing uncertainty around Greece and the possibility of a further slowdown in the Eurozone could be a negative influence on UK goods exports. As such, domestic demand will remain a key driver of growth.
Construction (6%)	7.3%	1.1%	2.0%	The construction PMI picked up in January after disappointing official data for Q4 2014. Residential house building is expected to remain reasonably buoyant in 2015.
Distribution, hotels & restaurants (14%)	4.7%	3.3%	2.4%	Retail sales volumes have generally been on an upward trajectory since 2013, with growth picking up in Q4 2014 following the slowdown seen in Q3. Falling unemployment and improving real wage growth caused by low inflation rates will lift consumer purchasing power and keep strong growth going at least in 2015.
Business services and finance (31%)	3.7%	3.5%	3.1%	The UK's large and relatively strong business services sector continues to experience strong growth. The financial sector remains exposed to the risks stemming from the Eurozone, regulatory changes and global financial market volatility.
Government and other services (23%)	1.1%	1.0%	1.2%	Government spending should continue rising at only a relatively modest pace given continuing efforts to control the budget deficit.
Total GDP	2.6 %	2.5%	2.3%	

Sources: ONS for 2014, PwC for 2015 and 2016 main scenario projections and key issues. These are only five of the most important sectors of the economy, so their GVA shares only add up to around 84% rather than 100%.

⁴ Though we would stress that sectoral projections for 2016 remain highly provisional at this early stage, with wide margins of uncertainty surrounding the illustrative projections in Table 2.3 for next year.

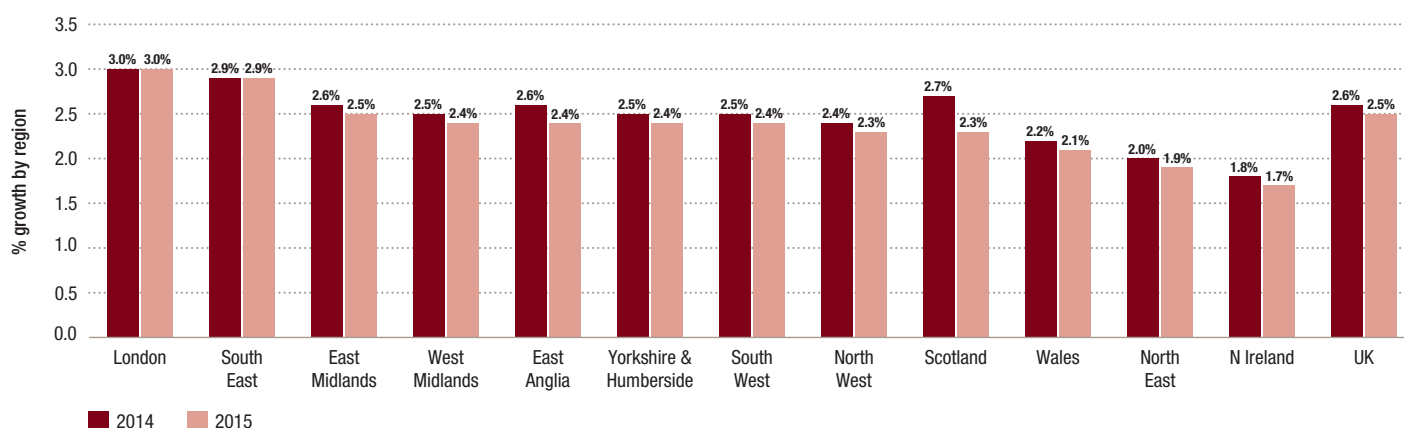
Regional prospects

Figure 2.9 shows our projections for growth in the main UK regions for 2014 and 2015. London and the South East⁵ are expected to retain their positions as the two fastest growing regions this year with a growth rate similar to the previous year. Most other regions are expected to expand at a slightly slower rate than the UK average this year, but all should see positive growth of more than 1.5% in 2015.

It is important to note that regional data are much less timely than national data – the latest available regional GVA data are for 2013⁶. As a result, the margins of error around these regional projections are even larger than for the national growth projections and so they can only be taken as illustrative of broad directional trends. Small differences in projected growth rates between regions are not of any practical significance.

London and the South East are expected to retain their positions as the two fastest growing regions this year with a growth rate similar to the previous year.

Figure 2.9: PwC main scenario for output growth by region



Source: PwC analysis

2.3 Outlook for inflation and real earnings growth

The headline CPI inflation rate was well below the Monetary Policy Committee's target of 2% in 2014 and dipped further to a record low of 0.3% in January 2015.

The lagged effects of past reductions in global energy and food prices were the main contributors to this sharply declining headline inflation rate, although core inflation (excluding food, drink, tobacco and energy costs) remained higher at 1.4% in January

2015, and has actually risen slightly from 1.2% in November. It seems therefore that, as the Bank of England has said, around two thirds of the slowdown in inflation relative to the 2% target is attributable to the effect of factors that are temporary in nature and whose impact would be expected to dissipate toward the end of the year, barring further falls in global commodity prices.

There is no sign yet in the UK of the systemic deflation experienced in Japan in the 1990s and the Eurozone more recently.

In our main scenario, we expect the annual rate of inflation on the Consumer Prices Index (CPI) measure to average 0.3% this year. This is significantly below the average of 1.5% reported in 2014. We expect inflation to regain momentum in 2016, bringing the rate closer to its target level of 2% by the end of next year (see Figure 2.10).

As with our GDP scenarios, we have also considered two alternative scenarios for UK inflation:

⁵ As discussed in detail in Section 4, this is a long term trend linked in part to the prominent position of London in new computer-related areas of work, with positive spillovers to other parts of the South East.

⁶ This significant regional data lag explains why we do not attempt to make regional growth projections for 2016 at this time.

- In our **‘high inflation’ scenario**, we assume that a combination of stronger global growth, a marked rebound in oil prices and resilient developments in domestic cost growth will push headline CPI inflation back up to around 3% on average in 2016.
- In our **‘low inflation’ scenario**, by contrast, we assume that UK domestic demand growth will be slower, global GDP growth rates deteriorate and commodity prices remain weak. As a result, the average annual inflation rate in this scenario would remain very subdued, averaging only just above zero in 2016. In this scenario, we expect negative inflation rates for several quarters in 2015 (as compared to only for a month or two in our main scenario).

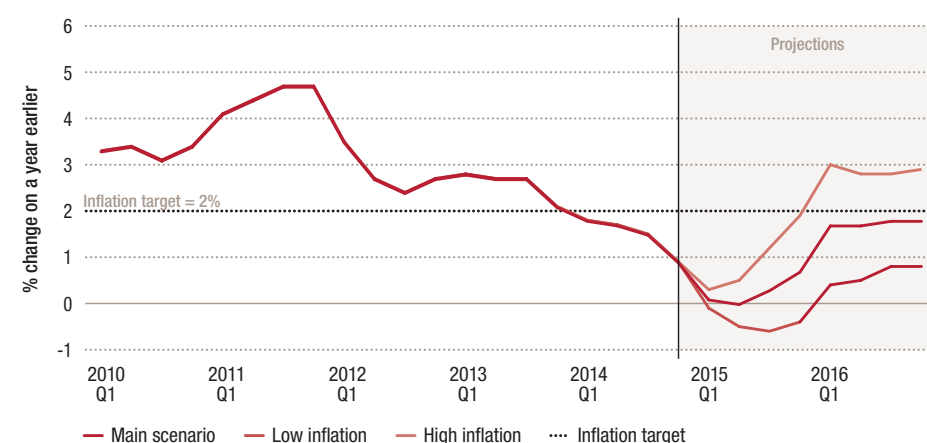
As with GDP growth, these alternative scenarios are not as likely as our main scenario, but businesses should plan for such contingencies.

Outlook for real earnings growth

As shown in Figure 2.11, real average earnings growth was pushed into negative territory for 6 years up to 2014, with real growth rates averaging -1.2% per annum during that period. However, the real earnings squeeze experienced in 2014 was very modest compared to earlier years. The largest real earnings squeeze was experienced in 2011 with a fall of 2.5%.

In 2015, our main scenario is that the squeeze will end and real earnings will exhibit positive growth. This is due primarily to the very low consumer price inflation rate expected in 2015, as discussed above. This positive growth in real earnings is expected to continue in the following few years, as Figure 2.11 shows, but the level of real earnings would not be expected to regain pre-crisis peaks until late in this decade.

Figure 2.10: Alternative UK inflation (CPI) scenarios



Source: ONS, PwC scenarios

Figure 2.11: CPI inflation vs nominal earnings growth



Source: ONS, PwC analysis

2.4 Monetary and fiscal policy options

The Monetary Policy Committee (MPC) again agreed to maintain the Bank Rate at 0.5% and the stock of purchased assets financed by the central bank reserves at £375 billion at its February meeting. However, for two members, the decision was “finely balanced” as the case for increasing the Bank Rate later this year is strengthened by the outlook of domestic inflationary pressures in the medium term. Against this, for one member of the MPC, the likelihood of a monetary policy tightening was the same as loosening.

It seems unlikely that there will be an early rate rise (certainly not before the general election in May), but we would expect the debate on the MPC to pick up again as long as the recovery continues through the year and there are no major adverse global shocks. In this case, we might expect the first rate rise in late 2015 or possibly early 2016, though any such increases are likely to proceed at a very gradual pace.

Therefore we might expect interest rates to increase to around 2% by the end of 2017 and to around 3.5-4% by 2020. Business and individuals should consider such rises in the cost of borrowing moving forward, as well as stress testing against rate rises where these would have major effects on their finances.

The latest public sector finances data saw a strong budget surplus in January. It now seems likely that the budget deficit will come in at around £90 billion in 2014/15 as a whole, similar to the OBR's forecast in December but somewhat higher than the implied forecast at the time of the March 2014 Budget (although definitional changes since then make a precise comparison difficult).

Fiscal policy plans for 2015/16 and beyond will be reviewed in the Budget, which the Chancellor will deliver on 18 March. We would not expect any major change in the overall fiscal stance, with any ‘giveaways’ being broadly balanced by ‘takeaways’. However, whatever the composition of the next government, further fiscal tightening is likely for at least the next 2-3 years, though the tax and spending plans of the different parties diverge more after that period.

2.5 Summary and conclusions

The pace of the UK economic recovery eased slightly in the fourth quarter of 2014, but remains relatively strong compared to the rest of Europe.

Consumer spending has been a key driver of this growth and the upward trend in investment in recent years has also helped to support growth (despite a dip in investment in Q4 2014).

The services sector remains the main engine of growth as it has consistently outperformed the manufacturing and construction sectors, but both of these also showed some recovery in 2014.

In our main scenario, we expect the UK economy to grow by around 2.5% in 2015, helped by the boost to household spending power from lower oil prices, before slowing slightly to around 2.3% in 2016. We expect London and the South East to continue to be the fastest growing parts of the UK in 2015, but all regions should show positive growth of more than 1.5% this year in our main scenario.

Our main scenario projection is for inflation to remain a long way below the Monetary Policy Committee's (MPC) inflation target of 2% this year, but then pick up towards target in 2016, on the assumption that oil prices rise gradually over this period. We would not dismiss the possibility of an interest rate rise later this year if the MPC sees domestic inflationary pressures mounting in the medium term.

Significant uncertainties continue to surround the UK recovery, with risks stemming from the recent problems in Greece and elsewhere in the Eurozone, and continued geopolitical tension in Russia/Ukraine and the Middle East. However, there are also upside possibilities due to the continued robust growth in investment and consumer spending, particularly if oil prices remain low (as discussed in more detail in the next section of this report).

In summary, the UK's recovery remains relatively robust, but the international environment continues to be a source of downside risks.

3 – The impact of lower oil prices on the UK economy

Key points

- The significant fall in oil prices since mid-2014 should increase overall UK economic activity as the cost of production decreases for businesses, especially for those that are heavily dependent on oil inputs. This will boost both investment and employment.
- Although the oil and gas extraction sector is negatively affected by the reduction in the oil price, sectors such as agriculture, air transport, coke and refined petroleum manufacturing and oil-intensive manufacturing sectors will benefit as the price of their key input falls.
- Water transport and other services sectors will enjoy a small positive impact. However, oil-intensive sectors are likely to benefit from the reallocation of capital and resources at the expense of less oil-intensive sectors.
- We use a model of the UK economy to quantify these effects in three alternative scenarios. In a case where the reduction in the oil price is permanent, settling at around \$50 per barrel, the size of the UK economy (GDP) increases by around 1% on average relative to the baseline between 2015 and 2020. Employment also increases by around 90,000 by 2020, with a peak boost to employment of around 120,000 in 2016.
- In contrast, the impacts are smaller where the fall in the oil price is temporary: depending on how far and fast oil prices rebound, the boost to GDP could vary from 0.2-0.5% and the increase in employment by 2020 could vary from 3,000 to 37,000.
- Real household incomes also rise as oil prices fall, which increases consumer spending. This is due to two factors: overall consumer prices fall as cost savings are passed on to households and real wages increase as demand for labour rises in fast-expanding sectors.
- As a result of growing economic activity, government tax revenues also rise as the tax take from corporate and personal income taxes increase, more than offsetting declining revenues from the oil and gas sector. The fall in the oil price should also have a small impact in narrowing the UK trade deficit.

The significant fall in oil prices since mid-2014 should increase UK economic activity.

Introduction

The dramatic decline in oil prices since mid-2014 is having a significant impact on the world economy. How does such a large and unexpected decline in oil prices affect the UK economy specifically, and which industry sectors are likely to emerge as winners or losers? How does a change in the oil price affect UK government revenues and the trade balance?

In order to answer these questions, we used our dynamic computable general equilibrium (CGE) model to assess the impact of future changes in the oil price on the UK economy. We used three projected oil price scenarios that differ in the magnitude and persistence of the oil price shock, against a baseline where oil prices remain at mid-2014 peak levels.

The rest of the article is structured as follows:

- Section 3.1 discusses past trends in oil prices and the UK's trade position in crude oil and oil products.
- Section 3.2 sets out our oil price scenarios and modelling approach.
- Section 3.3 discusses the results from the analysis.
- Section 3.4 summarises and draws conclusions from the analysis.

3.1 Trends in oil prices and the UK's position

Trends in oil prices

Oil prices mostly traded above the US\$100/barrel mark over the four years to mid-2014. However, by mid-January 2015, oil prices had fallen dramatically to around a third of their peak level in June 2014 and, despite some recovery since mid-January, remain well below those levels. The recent fall in oil prices was one of the biggest in history, with the only comparable declines in recent decades being the oil price collapse in the 1980s and in the 2008-9 global financial crisis. The latter was reversed relatively quickly, but the former proved to be long-lasting, so we need to explore how different scenarios for future oil price movements will influence the economic impact of the recent decline.

A combination of supply- and demand-side factors led to this sharp decline. On the supply-side, strong growth in production by non-OPEC producers and growing US shale oil production have contributed to an overall increase in output. Added to this is the apparent strategy of OPEC producers led by Saudi Arabia (who have lower production

costs) to maintain production levels in order to defend and grow market share by forcing more expensive unconventional sources out of the market. On the demand-side, the decelerating pace of growth in China and the slow economic recovery in the EU have contributed to weakening demand for oil.

These factors combined have exerted downward pressure on prices. In addition, oil consumers are taking advantage of the opportunity to stockpile cheap oil, which could further dampen demand for oil in the short-term.

In the longer term, technological advancements will continue to drive down the costs of extracting unconventional shale gas and tight oil reserves (including hydraulic fracturing or “fracking” methods), which will bolster non-OPEC oil supply. Furthermore, the rebalancing of the Chinese economy away from manufacturing to services could have a negative impact on oil consumption.¹ Growth in other developing countries, increasing energy efficiency and the shift towards renewable energy in developed countries could mean that

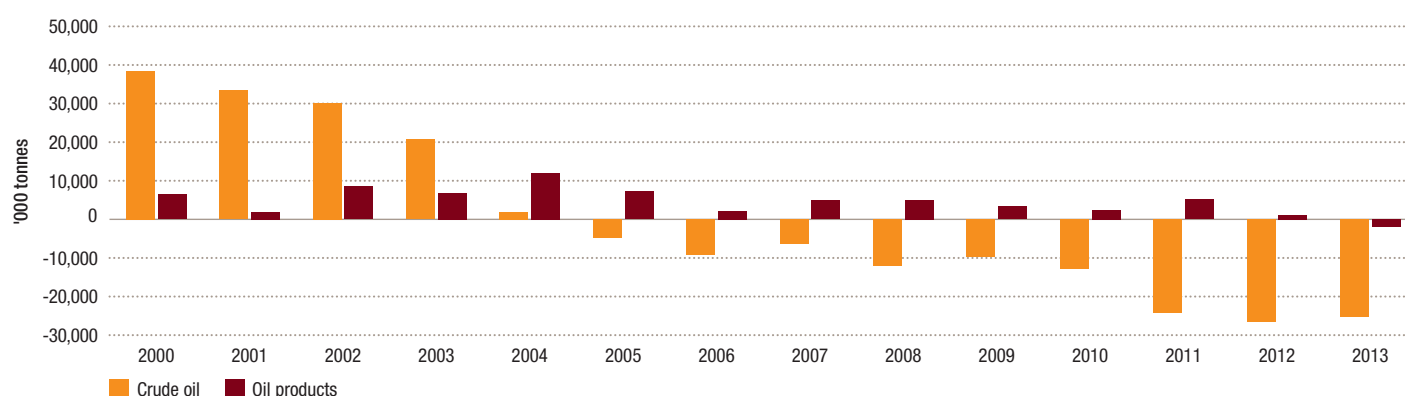
demand for oil is increasingly driven by developing countries rather than developed countries.

The net impact of these factors is unclear, but could imply a return in the longer term to a level of oil prices in line with marginal supply costs, which at current and projected levels of global demand might be around \$70-100 per barrel. The path by which prices return to this kind of level is, however, highly uncertain, as is the pace of any such adjustment.

The UK's position

The UK is the largest producer of oil and second-largest producer of natural gas in the European Union. Production from UK oil and natural gas fields in the North Sea peaked around the late 1990s and has declined steadily since as the discovery of new reserves and new production has failed to keep up with the maturity of existing sites. Figure 3.1 shows the UK's position in terms of net exports of crude oil and oil products. Following years of being a net exporter of petroleum and natural gas, the UK became a net importer of crude oil from 2005, and oil products from 2013.

Figure 3.1: UK net exports of crude oil and oil products²



Source: DECC

¹ IMF (2013) “Commodity Market Review”, October 2013.

² Crude oil includes the production of crude oil and natural gas liquids, petroleum products are refined crude oil. A negative value signifies that in that particular year imports were greater than exports.

Figure 3.2 compares the historic real growth in GVA for the UK oil and gas sector and for the rest of the economy. The oil and gas sector – which consists of the extraction of crude petroleum and natural gas and the manufacture of refined petroleum products – has shrunk to around a third of its size since its peak in the late 1990s. The sector now accounts for less than 2% of total UK GVA, as compared to 6% in 1999.

3.2 Modelling the impact of oil price shocks on the UK economy

Our modelling approach

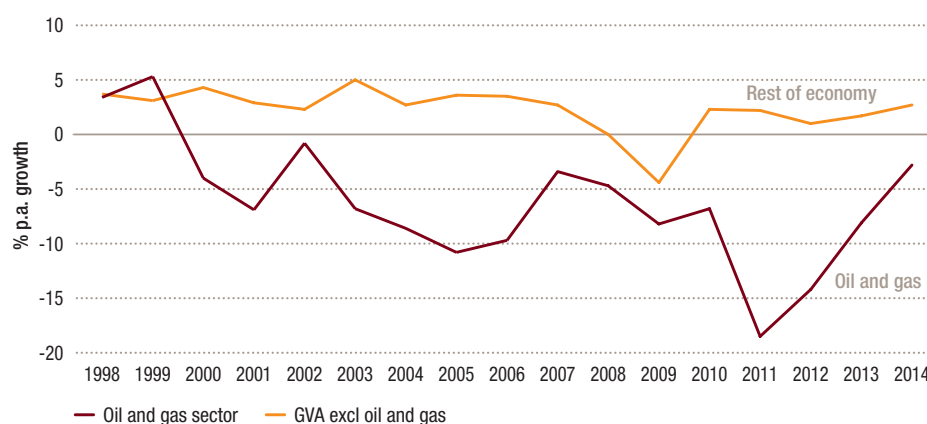
We used a computable general equilibrium (CGE) model to assess the impact of future changes in the oil price on the UK economy in three alternative scenarios. The model estimates how the UK economy would react to changes in policy, technology and other external factors by looking at the interactions between different industrial sectors, households, the government and the rest of the world. These models are a standard tool of empirical economic analysis, and are widely recognised and used by international organisations such as the IMF, OECD and the World Bank, as well as the European Commission, national governments and central banks.

We simulate an oil price shock in this model by reducing the output price of the oil and gas extraction sector and the input price of other sectors in the economy, which takes into account the relative oil intensity of the different sectors.

Oil price scenarios

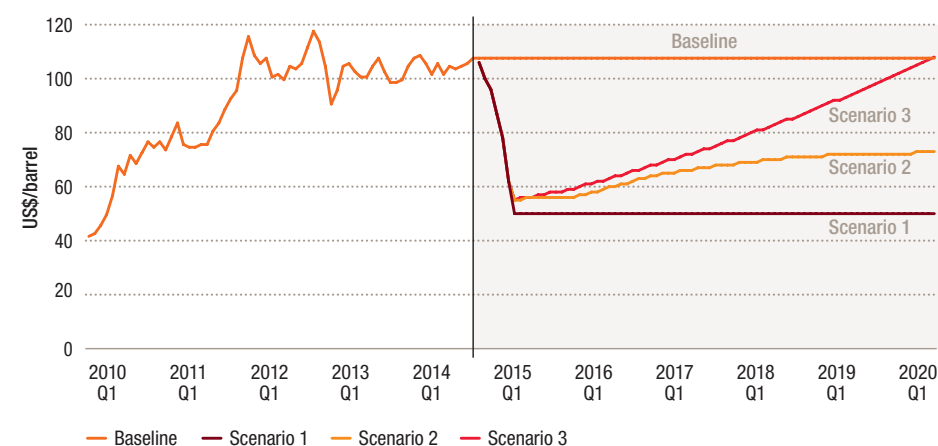
We assess the following three scenarios for the period to 2020 (shown in Figure 3.3):

Figure 3.2: Real GVA growth for oil and gas sector vs rest of UK economy



Source: ONS

Figure 3.3: Alternative oil price scenarios



Source: PwC analysis, IMF

- **Scenario 1:** Oil price remains at a low level of US\$50/barrel.
 - **Scenario 2:** Oil price gradually increases to US\$73/barrel in 2020.³
 - **Scenario 3:** Oil price gradually returns to US\$108/barrel in 2020.
- The CGE model measures the impact of each scenario relative to a baseline

³ The forecasts for Scenario 2 were drawn from the IMF's projections published in January 2015. This scenario is also broadly consistent with our main scenario for the UK economy in Section 2 above.

where the oil price remains at its mid-2014 peak of around \$108 per barrel. This baseline is also consistent with our growth projections for the UK economy published in the July 2014 issue of the UK Economic Outlook. The model also assumes longer-term UK economic growth to be in line with historical trend growth rates.

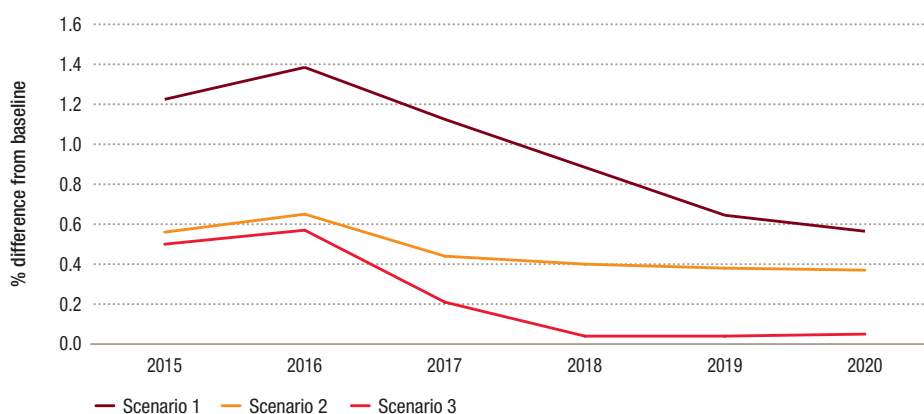
3.3 Results from our analysis

The results from the modelling show that the UK economy will be significantly affected by a reduction in oil prices. Although North Sea oil producers and refiners will experience a reduction in output, the UK economy benefits as a whole. Generally, the fall in oil prices increases overall economic activity as the cost of production decreases and investment increases. Consumers also benefit from lower energy costs and cheaper goods and services, which boosts real incomes and translates into an increase in consumption. Below we present and discuss these results in more detail.

Impact on overall UK GDP

Figure 3.4 shows the impact of the change in oil price on the level of UK real GDP.⁴ As shown in Figure 3.4, in Scenario 1, where the oil price remains persistently low at US\$50 per barrel between 2015 and 2020, the initial impact will raise the level of real UK GDP by around 1.2% in the first year relative to the baseline where oil prices remained at \$108 per barrel. The effect peaks in 2016 when the level of GDP increases by around 1.4% of the baseline level as the full impact of the oil price shock filters through the economy. The impact then tails off to around 0.6% of the baseline as the UK is exposed to stronger competition by cheaper imports

Figure 3.4: Impact on the level of real GDP, 2015-2020



Source: PwC analysis

from other countries that also benefit from the oil price shocks, thus diminishing the benefit to the UK.

In Scenario 2 where the oil price recovers gradually to \$73 by 2020 in line with latest IMF projections, UK GDP is estimated to be around 0.5% higher on average over the 2015-20 period relative to the baseline.

In Scenario 3, where the oil price recovers to mid-2014 levels by 2020, the impact on the economy is much smaller at 0.2% on average over the 2015-20 period, with minimal effects on the level of GDP by 2020 given this is a purely temporary shock in this scenario.

The model assumes adaptive expectations, which means that economic agents revise their expectations of future oil prices during each period based on current oil prices. The implication of this assumption is that there is a lag between the initial oil price shock and the subsequent economic impact. The stickiness of downward price adjustments also means

that the impact of the oil price shock takes time to filter through the economy.

In the following sub-sections, we set out the rest of the findings from our analysis, particularly with regard to sectoral GVA and employment, inflation, household consumption, UK government revenues and the trade balance.

Impact on output by industry sector

Figure 3.5 maps the transmission of a fall in the oil price at the industry sector level. We distinguish between the oil and gas extraction sector, sectors with oil-intensive production processes, and sectors that use oil and gas less intensively in their production processes. Our analysis focuses on the impact of the fall in the oil price on the UK as a whole, rather than focusing on specific regions within the UK. However, there are likely to be regional differences, depending on the distribution of oil-intensive industries across the regions.⁵

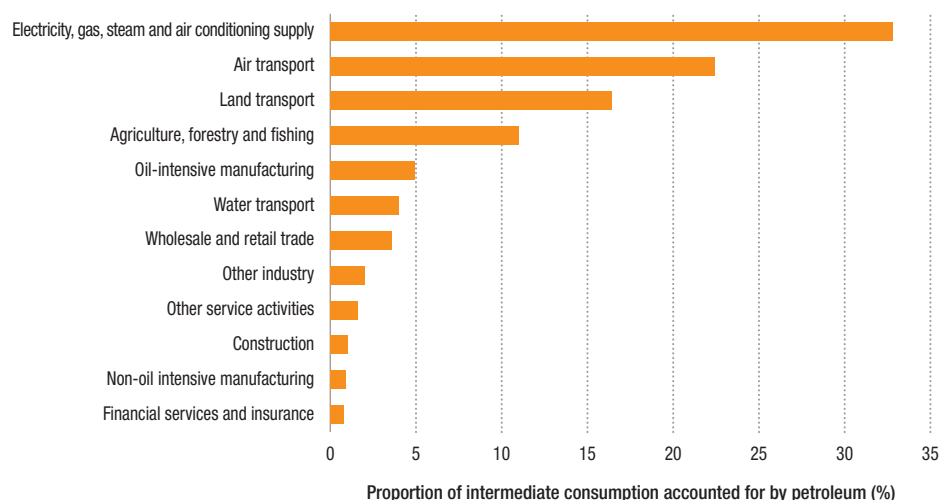
The CGE model takes into account the “reorganisation effect”, where firms automatically adjust their production

⁴ See the technical appendix for comparisons of the results of our study with existing academic literature.

⁵ In particular, the area around Aberdeen may be a loser given the concentration of onshore oil and gas activity there. Some parts of the North and Midlands may also benefit more from impacts on oil-intensive heavy industry, but our model does not allow quantification of these regional variations.

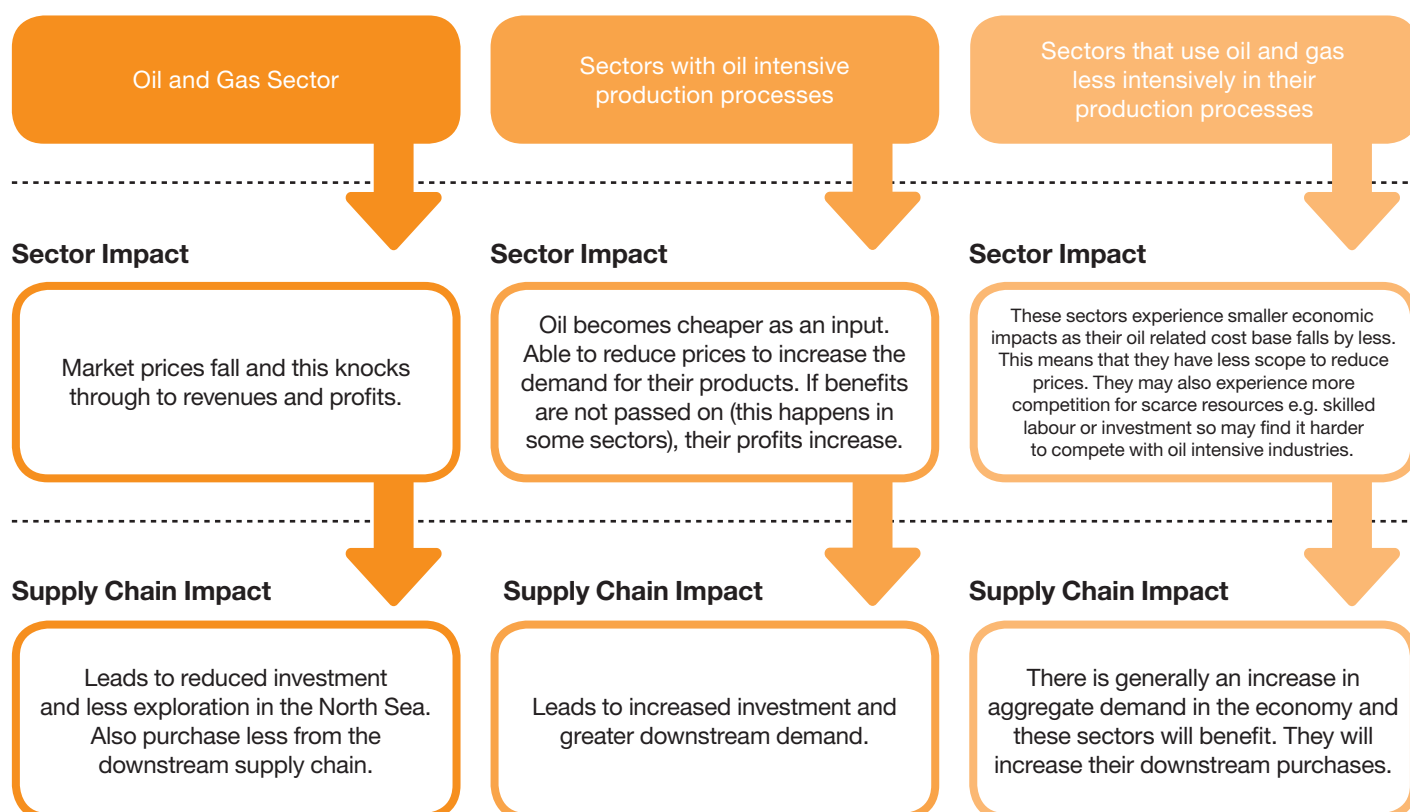
processes in response to changes in input prices, such as wage costs and the cost of intermediate inputs. As the prices of intermediate inputs, such as oil, fall, firms reorganise their activities to make efficient use of cheaper inputs, enabling them to increase output. Oil-intensive sectors such as the utilities, transportation, agriculture and oil-intensive manufacturing sectors (see Figure 3.6) are likely to benefit most. Within the oil-intensive manufacturing sector, oil and gas-related inputs and energy consumption account for at least 10% of total intermediate consumption for the following sectors: the manufacture of refined petroleum, industrial gases and chemicals, cement and metals.

Figure 3.6: Oil intensity by sector, 2014



Source: ONS

Figure 3.5: Transmission mechanism of a fall in the oil price



The model also assumes that workers can move between sectors as these expand or contract. If wages rise in a sector that benefits from the fall in the oil price, then we can expect workers to move into this sector to gain from the wage rise. The model also assumes a temporary loss in productivity to take into account the fact that people need to be retrained when moving between sectors, and consequently, their wages fall during this period.

Table 3.1 shows the average estimated impact of the fall in the oil price on the level of real GVA by sector between the years 2015 and 2020. Average impacts are smaller in Scenarios 2 and 3 than in Scenario 1 as in these scenarios the scale of the oil price decline is defined to be smaller.

As we might expect, the modelling results suggest that sectors with oil- and energy-intensive production benefit most from a reduction in the oil price. These sectors will benefit from lower production costs, and these cost reductions are assumed to be largely passed through to consumers over time which in turn creates increased demand for their products. Higher levels of demand lead to increased investment and improved productivity. There will also be greater demand for exports and increased import competition. The increase in overall output also generates more demand for supplier inputs, which positively affects the downstream supply chain via the multiplier effect.⁶ This is combined with a further knock-on impact on aggregate demand as workers employed will spend more on goods and services in the UK economy.

In **Scenario 1** with persistently low oil prices, the agriculture, air transport,

Table 3.1: Impact on level of real GVA by sector, average for the years 2015-2020

Average % difference from baseline	Scenario 1	Scenario 2	Scenario 3
Agriculture, forestry and fishing	2.3%	1.1%	0.3%
Air transport	2.1%	1.0%	0.3%
Manufacture of coke and refined petroleum products	1.6%	0.7%	0.6%
Oil-intensive manufacturing	1.4%	0.6%	0.4%
Other industry	1.4%	0.6%	0.3%
Construction	1.2%	0.6%	0.1%
Non-oil intensive manufacturing	0.9%	0.5%	0.4%
Financial services and insurance	0.7%	0.3%	0.2%
Electricity, gas, steam and air conditioning supply	0.7%	0.3%	0.1%
Wholesale and retail trade	0.3%	0.1%	0.0%
Water transport	0.3%	0.1%	0.0%
Land transport	0.2%	0.1%	0.0%
Other service activities	0.0%	0.0%	-0.1%
Government	-0.1%	-0.1%	0.0%
Extraction of crude petroleum and natural gas	-7.9%	-4.0%	-2.2%

Source: PwC analysis

oil-intensive manufacturing and construction sectors all experience an expansion in output of around 1-2% of sector GVA. The coke and refined petroleum manufacturing sector also expands by around 1.6% in Scenario 1. Although the oil intensity of this sector is relatively high, the impact of the oil price fall is dampened due to its close linkages with the oil and gas extraction sector, which is negatively affected. Manufacturing sectors that are relatively oil-intensive and energy-intensive, such as the manufacturing of cement, industrial gases and chemical

products, metals, machinery and equipment and wood products, also experience an increase in output due to the fall in the oil price.

The benefits to manufacturers would not be uniformly positive and a reduction in oil prices could generate winners and losers. For instance, sectors that use large volumes of imported materials could benefit as transportation costs fall and overseas suppliers pass on the benefits they obtain from lower oil prices. However, sectors that operate in export markets may experience

⁶ The increase in demand for supplier inputs also leads to an increase in input prices.

increased competition from businesses who can now compete on price in these markets due to lower production and transportation costs.

The role of the transport sector, whether it be by land, sea or air, will be critical in determining the scale of any economic impacts from oil price reductions. Transport services are critical in facilitating trade within the UK and internationally. More specifically, although land transport is fairly oil-intensive, it is also a highly competitive sector. This means that although overall output volumes have increased, the reduction in oil prices could increase the number of new entrants to the sector, or force incumbents to expand the services they offer, thereby squeezing overall industry margins.

Our modelling also suggests that the construction sector could also gain significantly from a reduction in the oil price. As business investment rises following the rise in intermediate demand and consumer spending, we would expect the construction sector to be the key beneficiary. In order to expand, businesses will need to move to new premises, enlarge existing premises or engage in refurbishment, and the construction sector will be the primary provider of these services.

The financial services sector will experience a small positive impact on output as it facilitates the reallocation of capital and other resources to the sectors that want to invest in response to rising levels of demand. In general, oil-intensive sectors are likely to benefit from the reallocation of capital and resources at the expense of less oil-intensive sectors that deliver relatively lower returns to investors.

More generally the impact on the “other services” sector will be largely neutral. These sectors will benefit through increased demand for their products from other sectors of the economy that are expanding as well as increased consumer spending. However, the businesses in this sector may find increased competition for scarce resources, e.g. skilled labour and investment, which may limit their capacity to respond to this increased demand. A similar effect occurs in the public sector – growth in the sector is constrained by government spending plans, and the sector finds it difficult to retain skilled workers who leave for higher wages in the expanding sectors.

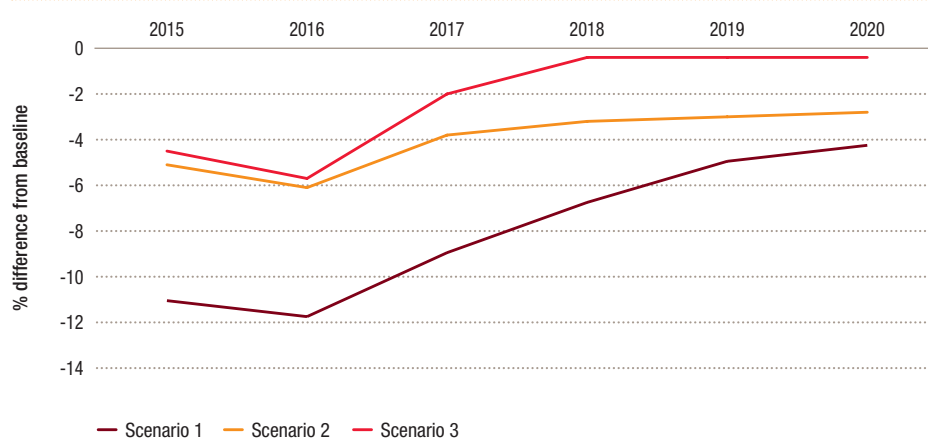
Although the fall in the oil price is associated with an increase in household spending, the wholesale and retail trade sector does not reflect all of the increase in spending as this sector only captures the value associated with activities related to the distribution, not the production, of manufactured goods.

Therefore, most of the value generated from increased household spending is reflected in the manufacturing and agriculture sectors. The primary product produced by the agriculture sector is food and raw material for clothing, so agriculture is therefore expected to experience a rise in demand associated with increased consumer spending. Similarly the manufacturing sector benefits because it produces consumer durables and clothing.

However, while these sectors may benefit from lower fuel costs, we have not taken into account any adverse corresponding economic effects that might dampen economic performance in these sectors and reduce their ability to pass on lower oil prices to their customers, e.g. a weaker outlook in the Eurozone may restrict their ability to invest.

The oil and gas extraction sector is most heavily impacted by the fall in oil prices (see Figure 3.7) and is the one sector

Figure 3.7: Oil and gas extraction sector - impact on level of real GVA, 2015-2020



Source: PwC analysis

that loses out significantly in terms of GVA. The industry is likely to face further cost pressures as highlighted in the recent Activity Survey published by Oil & Gas UK, which shows the costs of operating in the UK Continental Shelf rising by 8% in 2014, and production costs increasing from £17/barrel to £18.50/barrel.⁷

In Scenario 1, the oil and gas extraction sector suffers a severe contraction in output and employment during the first two years following a reduction in the oil price, with higher cost producers exiting the industry or scaling back their operations. A permanent reduction in the oil price could reduce the level of GVA in this sector by around 8% on average between 2015 and 2020, with a peak output loss of around 12% in 2016.

In Scenarios 2 and 3, where the oil price returns to a higher level, the oil and gas extraction sector could suffer a smaller contraction in output, which might moderate over time. The oil price will also have a negative effect on investment and exploration activity by the sector. There is some risk that a significant downturn could affect the ability of the industry to invest in major infrastructure (such as hub platforms and pipelines), causing the exploration of smaller and more technically difficult fields to become uneconomic.

Although the fall in the oil price is permanent, it triggers an increase in demand for oil as it is now a cheaper input. The fall in the oil price also narrows the growing spread between oil and gas prices, which slows the rate of switching from oil to gas, or to renewable sources of energy in the longer-term as

the cost saving incentives to do so are lessened. The increase in economic activity in other sectors also leads to a subsequent increase in the demand for oil. This rebound effect means that the contraction in output experienced by the oil and gas sector slows over time.

Table 3.2: Increase in total UK employment relative to baseline, 2016 vs 2020

Oil price scenario	2016	2020
Scenario 1 (staying at \$50)	121,000	91,000
Scenario 2 (rising to \$73 by 2020)	53,000	37,000
Scenario 3 (rising to \$108 by 2020)	11,000	3,000

Source: PwC analysis

Table 3.3: Impact on level of employment by sector, 2020, in thousands of full time equivalents

In thousands	Scenario 1	Scenario 2	Scenario 3
Construction	20.2	8.0	0.7
Wholesale and retail trade	18.9	7.8	0.7
Agriculture, forestry and fishing	13.4	5.3	0.5
Oil-intensive manufacturing	12.8	5.0	0.5
Land transport	10.9	4.5	0.4
Financial services and insurance	6.9	2.7	0.3
Non-oil intensive manufacturing	5.9	2.4	0.2
Other industry	4.4	1.8	0.2
Other service activities	2.1	0.9	0.1
Air transport	1.8	0.8	0.1
Electricity, gas, steam and air conditioning supply	1.2	0.5	0.0
Manufacture of coke and refined petroleum products	0.2	0.0	0.0
Water transport	0.0	0.0	0.0
Government	-4.2	-1.8	-0.1
Extraction of crude petroleum and natural gas	-2.9	-1.2	-0.1

Source: PwC analysis

⁷ Oil & Gas UK "Activity Survey 2015"

Impact on employment

The fall in the oil price will have a positive impact on employment, which is associated with increased levels of economic activity. The increased productivity and profitability among UK businesses that benefit from the fall in the oil price will increase demand for labour and capital, which, in turn increases wages and investment returns. Higher wages attract more workers into employment in these sectors, and unemployment falls.

Table 3.2 shows the increase in employment relative to the baseline for the UK economy in our three scenarios. The employment impacts peak in 2016 and moderate over time as the effects of lower oil prices filter through the economy. If there is a permanent reduction in the oil price, the economy will see an increase in employment of around 90,000 by 2020. The employment effects are smaller where the fall in the oil price is temporary: in Scenarios 2 and 3, the total number of jobs increases by around 37,000 and 3,000 respectively by 2020.

Table 3.3 shows the employment impacts by sector in thousands of jobs. The construction sector will see the largest increase in employment in absolute terms, followed by the wholesale and retail trade sector, and agriculture. The oil-intensive manufacturing sectors will also see an additional 13,000 jobs if the fall in the oil price is permanent. In percentage terms however (see Table 3.4), the agriculture, air and land transport sectors will experience the largest percentage increases in employment. As outlined above these sectors benefit from a rise in consumer spending. Both the agriculture and retail sectors

provide an entry point into the labour market for part-time or lower skilled workers, which make it relatively easier for these sectors to attract new workers and meet the predicted demand increase. The lower input costs for the manufacture of coke and refined petroleum also means that the sector will see an increase in employment of around 1.6% where the fall in the oil price is permanent. As described in the preceding section, the public sector experiences a fall in employment as public sector employees move to the faster-growing private sectors where wages are now higher.

The fall in the oil price will have a positive impact on employment.

Table 3.4: Impact on level of employment by sector, 2020, in % difference from 2013

% difference from 2013	Scenario 1	Scenario 2	Scenario 3
Agriculture, forestry and fishing	2.9%	1.2%	0.1%
Air transport	2.6%	1.1%	0.1%
Land transport	2.3%	0.9%	0.1%
Manufacture of coke and refined petroleum products	1.6%	0.6%	0.1%
Construction	1.6%	0.6%	0.1%
Other industry	1.5%	0.5%	0.1%
Oil-intensive manufacturing	1.4%	0.5%	0.0%
Electricity, gas, steam and air conditioning supply	0.8%	0.3%	0.0%
Financial services and insurance	0.7%	0.3%	0.0%
Non-oil intensive manufacturing	0.5%	0.2%	0.0%
Wholesale and retail trade	0.4%	0.2%	0.0%
Other service activities	0.0%	0.1%	0.0%
Government	-0.1%	0.0%	0.0%
Water transport	-0.1%	0.0%	0.0%
Extraction of crude petroleum and natural gas	-7.9%	-3.1%	-0.3%

Source: PwC analysis

Impact on inflation

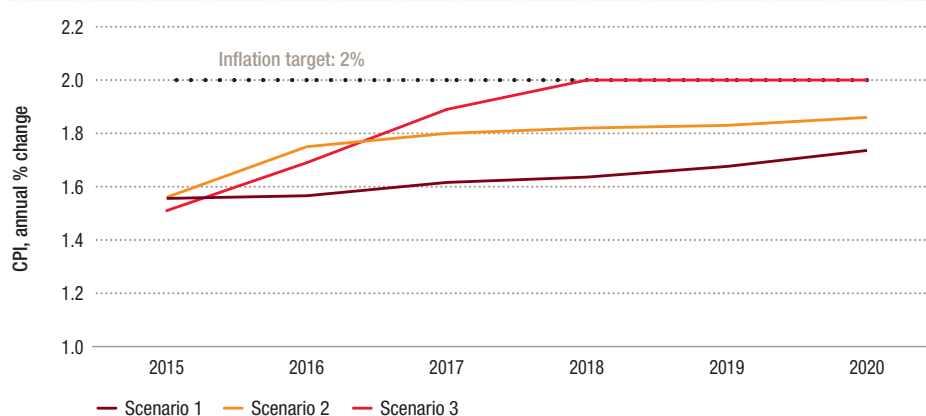
The lower cost of production from the fall in oil price across a range of energy-intensive goods will be passed on to consumers to varying degrees, and so reduce inflation directly as is already apparent in the latest CPI figures. Although the increase in real GDP and aggregate demand will exert upward pressure on prices, this is offset by the cost savings that translate into lower consumer prices. Figure 3.8 shows the modelled impact of negative oil price shocks on consumer price inflation in our three scenarios, relative to a baseline where inflation remained on target at 2%. Note that this ignores other factors that may affect inflation, so it is illustrative of how oil price changes alone affect inflation, rather than being forecasts of what we think inflation will actually be (for which readers should refer to Section 2 above).

Impact on household spending

Figure 3.9 shows average household expenditure per week on various goods and services. Expenditure on power and fuel (including for personal vehicles) account for around 11% of total weekly spend, or £50 per week.

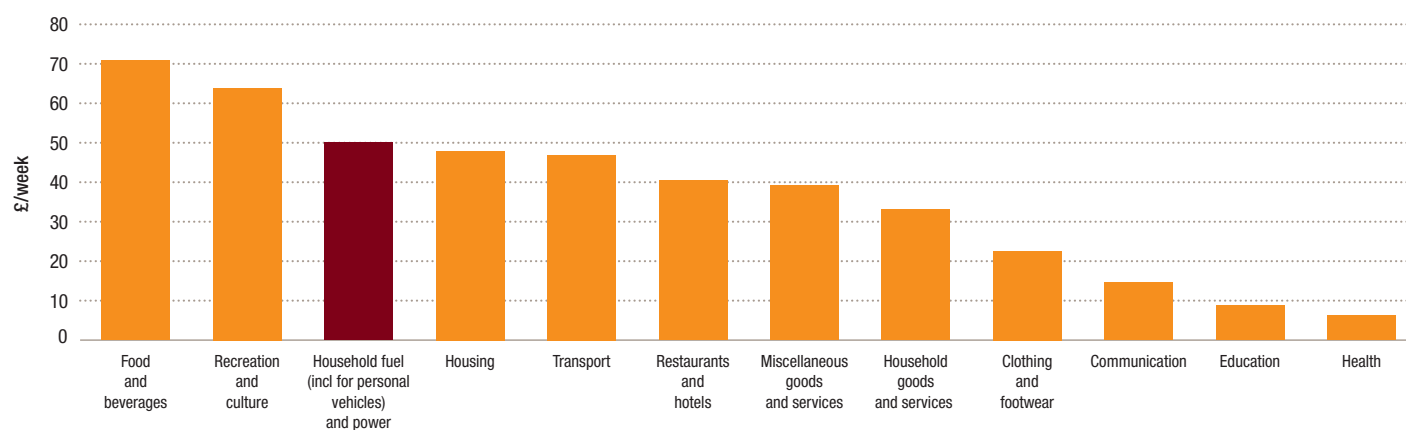
Our modelling suggests that consumers benefit overall from the reduction in oil prices as businesses pass on cost savings to consumers in the form of cheaper goods and services. However, less than 1% of electricity in the UK is generated from petroleum, so the fall in the oil

Figure 3.8: Impact on CPI inflation relative to baseline target level, 2015-2020



Source: PwC analysis

Figure 3.9: Household expenditure, average per week, 2013



Source: ONS

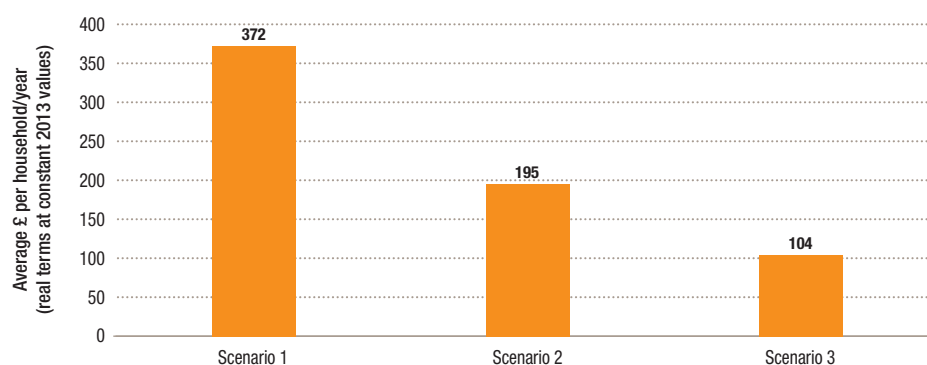
price will only have a minimal impact on the household electricity bills. Households should also benefit as the increase in demand for labour in fast-expanding sectors should increase the overall level of wages in the economy, thus increasing their spending power. This is offset slightly by the subsequent increase in prices due to the increase in demand for consumer goods and services, but the overall net impact is an increase in real household spending.

Figure 3.10 shows the impact on household spending in real terms as a result of the fall in the oil price. In Scenario 1, the persistently low oil price will enable household consumption to rise by an additional £372 a year in real terms on average between 2015 and 2020. Where the fall in the oil price is temporary, the impact on real household spending is smaller, increasing by £195 and just over £100 a year on average in Scenarios 2 and 3 respectively.

Impact on the trade deficit

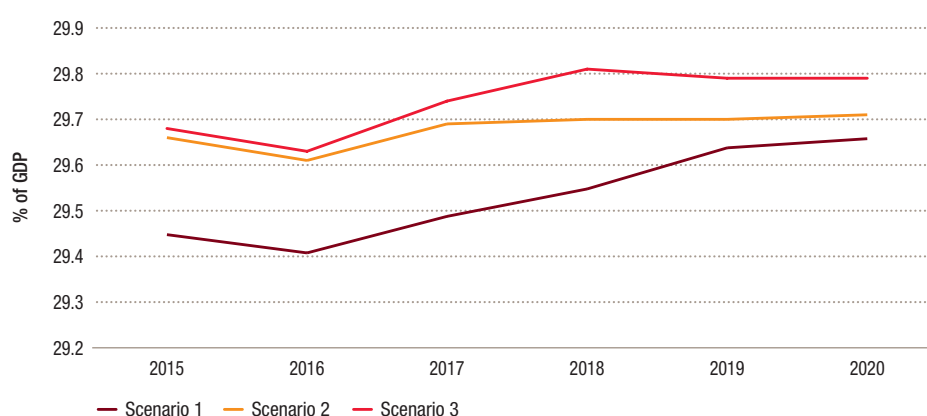
Figure 3.11 shows the impact on UK exports as a percentage of GDP, as a result of the fall in oil prices. As a net importer of crude oil and oil products, the fall in the oil price will provide a small benefit to the UK by narrowing the trade deficit. In Scenario 1, the expansion in other sectors also leads to an increase in exports. However, the value of exports decreases in the short-run as the wealth effect from the fall in the oil price means that more goods and services are being consumed domestically. This effect also explains why the impact on UK exports is less apparent in Scenario 1 in comparison to Scenarios 2 and 3.

Figure 3.10: Impact on real household spending average over 2015-2020



Source: PwC analysis

Figure 3.11: UK exports in different oil price scenarios, 2015-2020



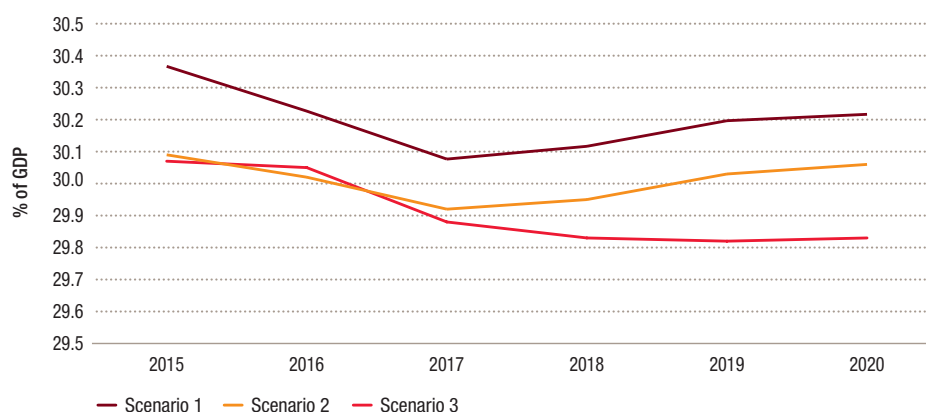
Source: PwC analysis

Figure 3.12 shows the impact on UK imports. Imports decline initially as the cost of oil imports fall. In the longer-term, although UK firms experience an improvement in international competitiveness and exports increase, this also generates wealth, part of which will be spent by households on increasing their consumption, including imported goods. This means that the impact on net exports is dampened as overall economic growth in the UK also drives up imports. On balance, our results suggest that the UK will enjoy a small narrowing of the trade deficit as a result of the fall in the oil price.

Impact on UK government revenues

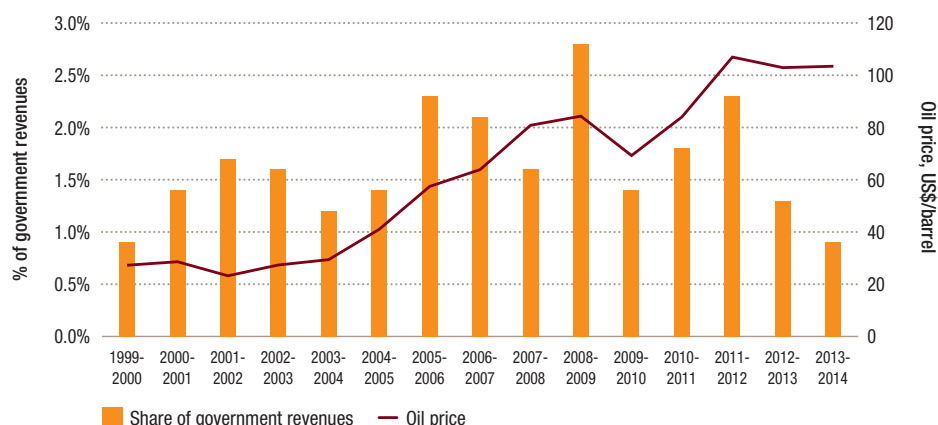
The UK oil and gas fiscal regime applies to exploration for, and production of, oil in the UK and on the UK Continental Shelf. This currently consists of corporation tax, the supplementary charge and the petroleum revenue tax. Figure 3.13 shows the trends in government tax receipts from the oil and gas sector compared to trends in oil prices. Up until fiscal year 2011-12, the share of government revenues from the UK oil and gas sector broadly followed trends in oil prices. However, this relationship began to decouple in recent years as significant declines in oil production and increasing costs led to a reduction in tax revenues from the sector. In 2012-13, tax revenues fell by around 45% to £6.1 billion, and then fell again in the following year by around 25% to £4.7 billion due to lower production levels and higher expenditure. These trends are linked to the increasing maturity of the North Sea fields as oil and gas from marginal sites become more expensive and difficult to extract.

Figure 3.12: UK imports in different oil price scenarios, 2015-2020



Source: PwC analysis

Figure 3.13: Revenues from the UK oil and gas sector



Source: ONS, Thomson Reuters

Our analysis suggests that the reduction in oil price will have a small positive impact on overall government tax revenues (see Figure 3.14). Although tax revenues from the oil and gas sector are likely to decline, rising tax contributions from other sectors of the economy will more than offset this loss as they expand. In Scenario 1, the UK government receives £6.7 billion on average in additional tax revenues between 2015 and 2020, which is around 1.4% of total tax revenues. The additional tax impacts from a temporary fall in the oil price are smaller – at around £3.2 billion and £1.3 billion in Scenarios 2 and 3 respectively.

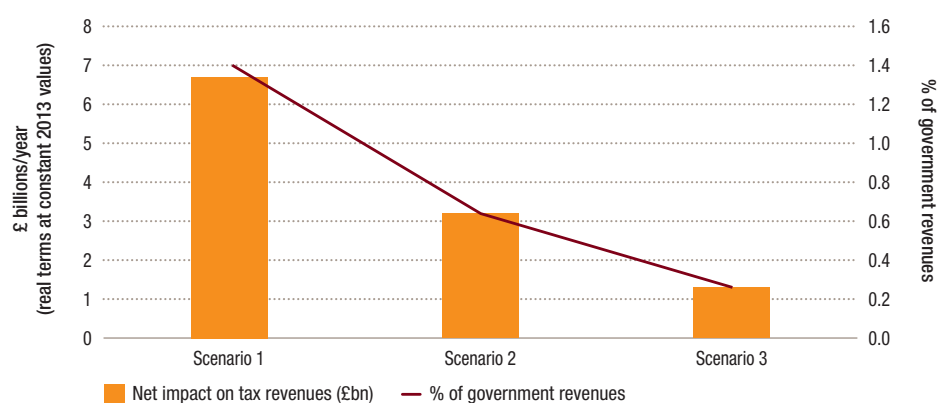
In our model we assume that the overall increase in government tax receipts is transferred back to consumers via lump-sum transfers, which provide a further boost to consumer spending and economic output.

3.4 – Summary and conclusions

The fall in the oil price should have a significant positive impact on the UK economy by increasing overall economic activity as the cost of production decreases for businesses, especially for those that are dependent on oil inputs. Although the oil and gas extraction sector is negatively affected by the reduction in the oil price, sectors such as agriculture, air transport, coke and refined petroleum manufacturing and oil-intensive manufacturing sectors will benefit as the price of a key input falls.

Water transport and other services sectors will enjoy a small positive impact. However, oil-intensive sectors are likely to benefit from the reallocation of capital and resources at the expense of less oil-intensive sectors.

Figure 3.14: Net impact on government tax revenues per annum, average over 2015-20



Source: PwC analysis

Future oil price trends remain highly uncertain, so we have looked at three alternative scenarios. In a case where the reduction in the oil price is persistent, the size of the UK economy increases by around 1% on average relative to the baseline between 2015 and 2020. Employment also increases by around 90,000 by 2020.

In contrast, the impacts are much smaller where the fall in the oil price is wholly or partially temporary: in these scenarios the average impact on the level of GDP is 0.2-0.5%, with employment effects in 2020 of between 3,000 and 37,000 depending on how far and fast oil prices rebound.

Real household incomes also rise, which increases consumer spending. As a result of growing economic activity, government tax revenues increase as the tax take from corporate and personal income taxes increase by more than the loss of North Sea oil and gas revenues.

In summary, lower oil prices should be positive for most sectors of the UK economy, households and the government. But the scale of these benefits remains highly uncertain depending on how oil prices evolve from here.

Technical Appendix:

Modelling oil price changes

Table 3.5 sets out the oil price projections for each scenario in our analysis.

As part of our modelling exercise, we also undertook a literature review of studies on the impact of an oil price shock on oil importing countries. Cournede (2010) found that an increase in the real oil price of 65% reduces US potential output by 1.3%, implying an elasticity of output to the oil price of around -0.02. The author found similar estimates for the EU where a 59% increase in the real oil price reduces EU potential output by 0.7%, which implies an elasticity of around -0.01. A more recent study by the Bank of England (2013) shows that an increase in oil price of around 10% leads to a reduction in output of around 0.2% in UK.

These estimates vary widely, depending on the oil intensity of the economy, dependence on energy imports and methodology. We compared the estimates of elasticities from the academic literature with our analysis, and found that our results were in line with most other estimates. These are summarised in Table 3.6.

Table 3.5: Oil price scenarios, US\$/barrel

Scenario	2015	2016	2017	2018	2019	2020
Baseline	108	108	108	108	108	108
Scenario 1	50	50	50	50	50	50
Scenario 2	57	64	68	71	72	73
Scenario 3	60	68	76	85	96	108

Note: Oil prices calculated as an average of Brent crude, WTI and Dubai.

Table 3.6: Estimates from academic literature compared to PwC estimates

Reference	Impact of a 1% increase in oil prices on GDP, %	Time period
PwC study	Scenario 1: -0.024% Scenario 2: -0.015% Scenario 3: -0.010%	5 years (projected)
Bank of England (2013) ⁸	UK: -0.02	36 years (1975-2011)
Peersman and Van Robays (2012) ⁹	US: -0.04 Euro area: -0.04	22 years (1986-2008)
Cournede (2010) ¹⁰	US: -0.02% EU: -0.01%	3 years (2007-2009)
Duval and Vogel (2008) ¹¹	OECD: -0.03%	10 years (projected)
Barrell and Kirby (2008) ¹²	UK: -0.04%	2 years (2008-2009)
Blanchard and Gali (2007) ¹³	UK (1970-1983): -0.1% UK (1984-2007): -0.02%	37 years (1970-2007)

⁸ Millard, S. and Shafir, T. (2013) "Oil shocks and the UK economy: the changing nature of shocks and impact over time", Bank of England Working Paper No. 476, August 2013.

⁹ Peersman, G. and Van Robays, I. (2012) "Cross-country differences in the effects of oil shocks", Energy Economics, Volume 34, Issue 5, September 2012, Pages 1532-1547

¹⁰ Cournede, B. (2010) "Gauging the impact of higher capital and oil costs on potential output", OECD Economics Department Working Papers No. 789, July 2010.

¹¹ Duval, R. and Vogel, L. (2008) "Oil price shocks, rigidities and the conduct of monetary policy", OECD Economics Department Working Papers No. 603, April 2008.

¹² Barrell, R. and Kirby, S. (2008) "The budgetary implications of global shocks to cycles and trends in output: impacts of housing, financial and oil shocks", October 2008.

¹³ Blanchard, O. and Gali, J. "The macroeconomic effects of oil price shocks: why are the 2000s so different from the 1970s?", NBER working papers No. 13368, 2007.

4 – New job creation in the UK: which regions will benefit most from the digital revolution?¹

Key points

- The digital revolution has both created and displaced many types of jobs since 1990. In this article, we focus on the new types of jobs created and assess how this has affected total national and regional employment in the UK since 2004. We highlight the key role of London as an incubator for the digital revolution, but also find some signs of catch up in other regions such as the North, Wales and Northern Ireland.
- We examined new job titles that emerged only after 1990 and found that 5.5% of the UK workforce had shifted into these new types of jobs by 2004. But by 2014 the proportion of workers in these new types of jobs had risen only slightly further to around 6%. Eight of the ten occupational categories in which these new job titles arose were related to computers, so this can largely be linked to the digital revolution.
- London has been the greatest motor of the creation of new types of jobs, outperforming the rest of the UK economy: for example, the proportion of total employment in new types of jobs in Central London was 8.6% in 2004, increasing to 9.8% in 2014.
- But we also find some evidence of regional convergence over the past decade. While London continues to lead in terms of the proportion of workers in new types of jobs, regions like Yorkshire, Tyne & Wear, Wales and Northern Ireland with low initial employment shares in new types of jobs in 2004 experienced higher growth rates of these new job types on average between 2004 and 2014.
- Our findings suggest that new types of jobs (linked mainly but not only to the digital revolution) initially appeared in areas like London where entrepreneurs, innovative firms and skilled workers were concentrated and then gradually diffused to other regions. These other regions will continue to catch up unless London's pace of new job creation is higher than the rate of regional diffusion.
- Projecting patterns in total regional employment growth over the next decade, we find that total employment in Central London could grow by around 25% between 2014 and 2024, but this would be down from around 35% total employment growth over the past ten years.
- By contrast, employment growth rates over the next decade in regions like West Yorkshire, Greater Manchester, the West Midlands, Scotland and the rest of the South East are projected to see some acceleration in job creation relative to the past decade as the digital revolution continues to diffuse.
- Future UK and London governments need to make sure that the city's growth potential is not constrained by the supply of housing and transport infrastructure. But it also needs to support the diffusion of digital job creation to other UK regions by boosting transport links outside London, supporting leading regional universities, and building skills, which we find to be a key driver of economic success for cities.

4.1 Introduction

Over the last hundred years, technological change² has fundamentally transformed labour markets in most industrial nations. In recent decades, the arrival of new digital technologies has displaced a wide range of routine work, including the jobs of bookkeepers, assembly workers, cashiers and telephone operators.³ At the same time, the appearance of more than 1,500 new occupational titles in official classifications since the computer revolution of the 1980s, suggests that a host of new occupations have emerged.⁴ In the United States, around 4.4% of total employment in 2000 was in types of jobs that did not exist in 1990.⁵

Many new occupations are directly related to the arrival of the personal computer (PC) in the 1980s and the subsequent internet (or 'digital') revolution that has rolled out since the early 1990s. Table 4.1 shows the detailed occupational categories with the highest proportions of new types of jobs between 1990 and 2010. 8 of the 10 occupational categories with the highest fractions of new job titles since 1990 were directly related to computer technologies.⁶ This also explains the high proportions of new job types in professional and technical occupations as shown in Figure 4.1.

1 This article was written by Dr Carl Benedikt Frey, Oxford Martin Programme on Technology and Employment, University of Oxford, and John Hawksworth, chief economist at PwC.

2 For more insights on this general phenomenon, please see PwC's megatrends and World in Beta websites at: <http://www.pwc.co.uk/issues/megatrends/index.jhtml> and <http://www.worldinbeta.com/>

3 Autor and Dorn (2013).

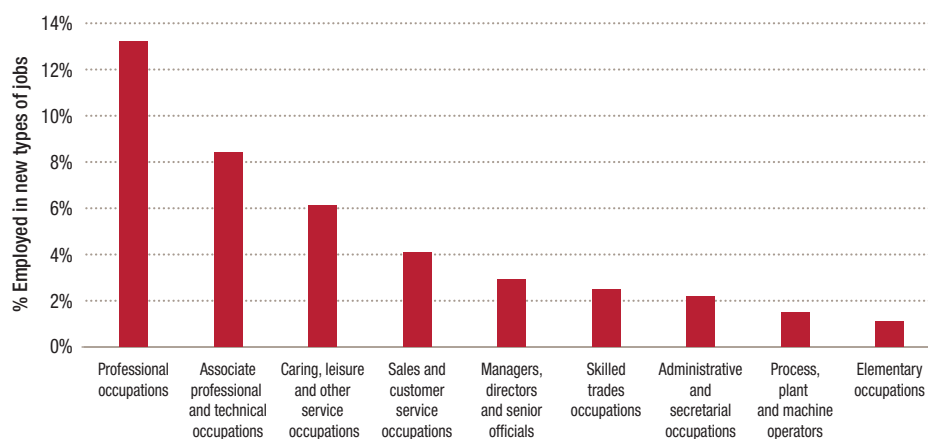
As computer technologies disrupt the world of work, making some occupations redundant in the process⁷, the key challenge for governments is to help support the shift of workers into new and emerging employment opportunities. A concern is therefore that the companies leading the digital age have created relatively few new jobs compared to the giants of the early computer revolution: while IBM and Dell still employed around 430,000 and around 110,000 workers respectively in 2013, Facebook's global headcount reached only 7,185 in that year. We turn next to examining the broader implications of this trend for the UK economy.

Table 4.1: Top 10 occupational categories in 2010 with the highest proportions of new job types that did not exist in 1990

Category	New job types (%)
Computer Software Engineers	80.0
Database Administrators	78.6
Network and Computer Systems Administrators	78.1
Computer and Information Systems Managers	76.5
Computer Support Specialists	71.4
Computer Programmers	59.1
Miscellaneous Personal Appearance Workers	50.0
Logisticians	50.0
Computer Hardware Engineers	50.0
Physical Therapists	50.0

Source: Lin (2011); calculations by Carl Frey using methodology described in the technical appendix. These proportions are derived from US data, but should be broadly similar for the UK in the same occupational categories, which is what we assume in the rest of this analysis.

Figure 4.1: Proportion of new job types by broad occupational category in 2010



Source: Calculations by Carl Frey based on methodology in technical appendix

⁴ Berger and Frey (2014a); Lin (2011).

⁵ Lin (2011).

⁶ Interestingly the other occupations with a high proportion of new types of work were in the personal care area (i.e. physical therapists and beauticians), which is one where computers cannot easily replace humans. This general area also sees relatively high levels of new work at the broad occupational level, as shown in Figure 4.1.

⁷ This will also change the nature of work for others, as discussed, for example, in PwC's report on the Future of Work (2014b): <http://www.pwc.com/gx/en/managing-tomorrows-people/future-of-work/journey-to-2022.jhtml>

4.2 New job creation in the UK economy

The UK labour market has witnessed a structural transformation since the early 1990s. In 2004, 5.5% of the UK workforce was already employed in occupations that did not exist in 1990 (see Technical Appendix A for details of the methodology and data used to produce this and other estimates in this section of the article). By 2014 the share of UK workers employed in these new types of occupations had grown further, but only relatively slowly, to around 6% (Figure 4.2).

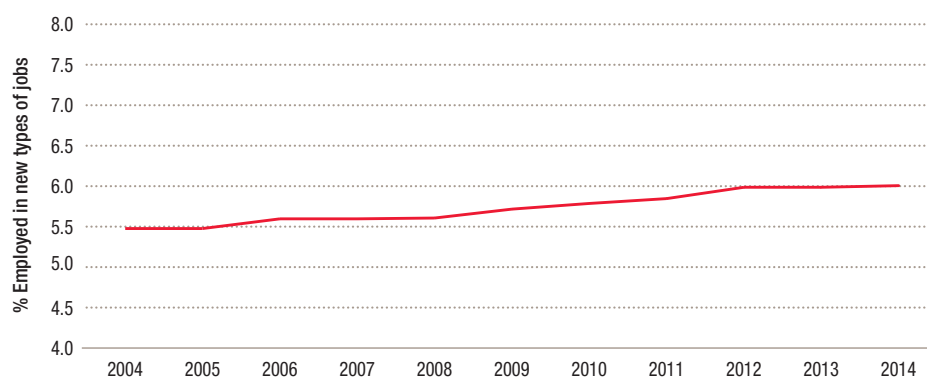
While we are unable to make cross-country comparisons due to lack of fully consistent data, our findings for the UK seem to largely reflect previous findings for the US. According to an earlier estimate around 4.4% of the US workforce in 2000 was employed in occupations that did not exist in 1990.⁸ This implies a broadly similar rate of increase over ten years in the US to the rise from zero⁹ to 5.5% over the 14 years to 2004 in the UK.

Furthermore, just as more recent rates of new job type creation in the UK have been relatively modest as shown in Figure 4.2, the US economy has witnessed a decline in some indicators of technological dynamism. In particular, the falling pace of job reallocation—the process by which workers move from contracting companies to expanding ones—has induced concern about the future of jobs.¹⁰ The slowdown in the rate of creation of new types of jobs in the UK over the last decade thus seems to reflect a broader tendency of digital technologies to create fewer jobs than the technologies of earlier computer revolutions.

It is important to note that this cannot be explained just as a cyclical phenomenon given that the period from 2004 to 2014 that is shown in Figure 4.2 probably covers close to a full economic cycle, with a relative strong period in 2004-7, then a deep recession in 2008-9 and a gradual recovery thereafter, picking up pace in 2013-14. Instead, there seem to be a more structural factor at work in the digital revolution directly creating a smaller number of jobs than earlier technological revolutions.

However, there may still be large indirect job creation effects as the extra wealth generated by the digital revolution filters down through the economy and the new technology increases the productivity of many existing occupations.

Figure 4.2: Proportion of employment in new types of jobs in the UK economy, 2004-2014



Source: ONS Labour Force Survey; calculations by Carl Frey using methodology described in the technical appendix

⁸ Lin (2011).

⁹ By definition, the proportion of workers in types of jobs that did not exist in 1990 would be zero in that year.

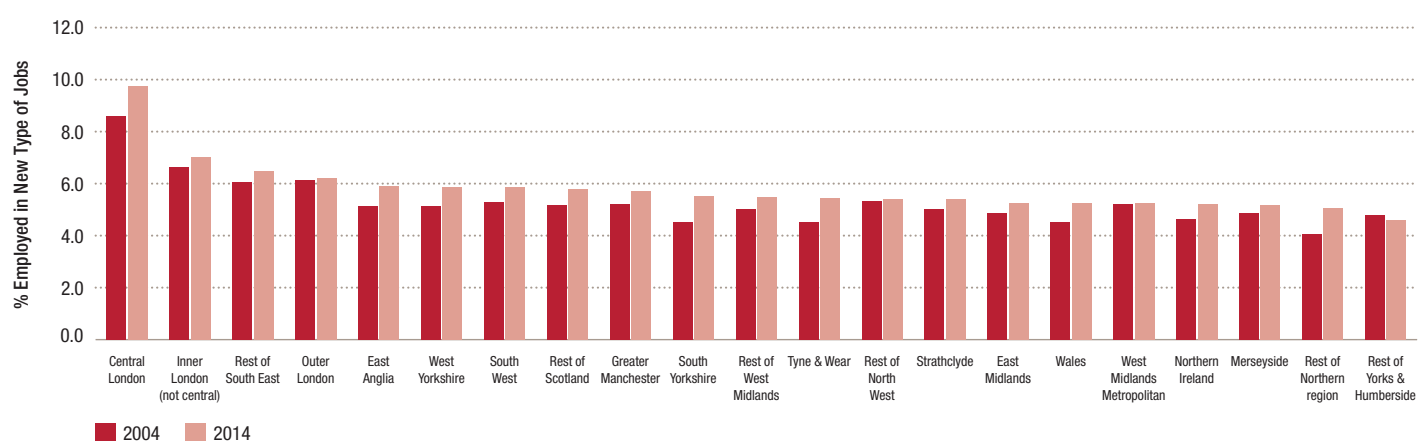
¹⁰ Decker et al. (2014).

The regional perspective

Nearly all UK regions have increased their employment in new types of jobs over the past decade. Nevertheless, London stands out relative to other regions, mainly due to its relatively high initial share of new work. In 2004, the share of employment in new work varied between 4.1% in Rest of Northern Region to 8.2% in Central London (Figure 4.3). Outside Central London, the creation of new types of jobs is somewhat more concentrated in surrounding areas, including Inner and Outer London as well as the South East, although other regional rates do not vary that much as Figure 4.3 shows.

The patterns observed in 2004 have largely remained in place since then. Central London has seen a further rise in the share of workers in new types of jobs over the past decade, reaching 9.8% in 2014. Inner London and the South East also experienced increases in new types of jobs, but we find that Outer London is falling slightly behind. By 2014, all regions had seen their share of new types of jobs increase, with the exception of Rest of Yorkshire & Humberside, which witnessed a small decline from 4.8% to 4.6%. In contrast, South Yorkshire substantially increased the share of its workers in new job types between 2004 and 2014, growing from 4.5% to 5.5%, suggesting some possible displacement of new jobs across the region.

Figure 4.3: Proportion of workers in new types of jobs in UK regions, 2004 and 2014



Source: ONS Labour Force Survey; calculations by Carl Frey using methodology described in technical appendix

4.3 Evidence of regional convergence, 2004-2014

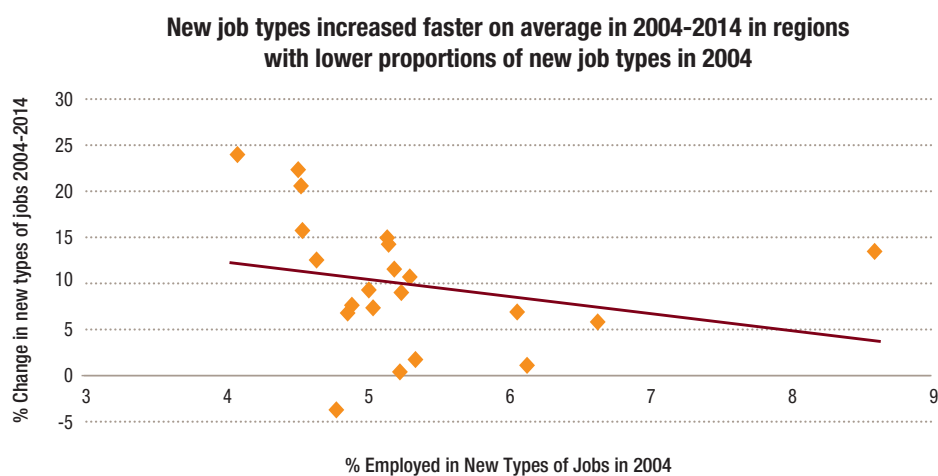
Despite the fact that Central London and surrounding regions still had higher proportions of workers in new types of jobs in 2014, the share of new jobs across UK regions converged over the past decade. As shown in Figure 4.4, regions with the lowest employment shares in new types of jobs in 2004 saw these shares increase the fastest over the next ten years, especially if one excludes Central London. The Rest of Northern region, with the lowest initial share of new work, experienced the fastest growth in new work over the past decade: the region increased its employment in new types of jobs by around 24%, closely followed by South Yorkshire (23%) and Tyne & Wear (21%).

These findings resonate with previous research showing that since the advent of the computer revolution new types of work have emerged more strongly in the most skilled cities.¹¹ Gradually, however, as the new work becomes “old” work, it diffuses to other cities and regions. Thus, new job creation in the digital area tends to be concentrated in cities like London, Oxford and Cambridge with a large pool of skilled workers, where entrepreneurs, innovators and early adopters experiment with new technologies.¹² Only after production processes have become more standardized does it tend to be widely adopted elsewhere.¹³

In other words, convergence occurs if the diffusion of “old” work takes place at a faster pace than new job creation. In line with the general trend of a slowdown in the creation of new work between 2004 and 2014, our findings suggest that the diffusion process took place at a relatively fast rate. Accordingly, regional convergence is not necessarily good news. As London remains the early adopter of the UK economy, the apparent slowdown in new digital job creation in London may imply a subsequent slowdown across other regions over the next decade.

These findings are interesting and surprising, given that the perception would be that in other high value added services e.g. financial and business services, the agglomeration economies pushing towards existing clusters would still be predominant. This seems, however, to be less true in digital sectors where economies of scale (and indeed physical location) may be less important and so activity can diffuse more widely across the country.

Figure 4.4: Regional convergence across UK, 2004-14



¹¹ Berger and Frey (2014a).

¹² Lin (2011); Berry and Glaeser (2005); Glaeser et al. (2012).

¹³ Duranton and Puga (2001).

4.4 Projected employment growth across UK regions, 2014-2024

Using data on employment growth by region between 2004 and 2014 from the ONS and the share of new types of jobs in each region in 2004, we estimate a simple ordinary least squares (OLS) regression where we examine the statistical relationship between new work creation and employment growth. Details are provided in Technical Appendix 4B, but we focus here on the key conclusions.

The main findings are that the share of new types of jobs in 2004 is a statistically significant predictor of subsequent total employment growth in a region. In fact, we find that differences in the share of new types of jobs can

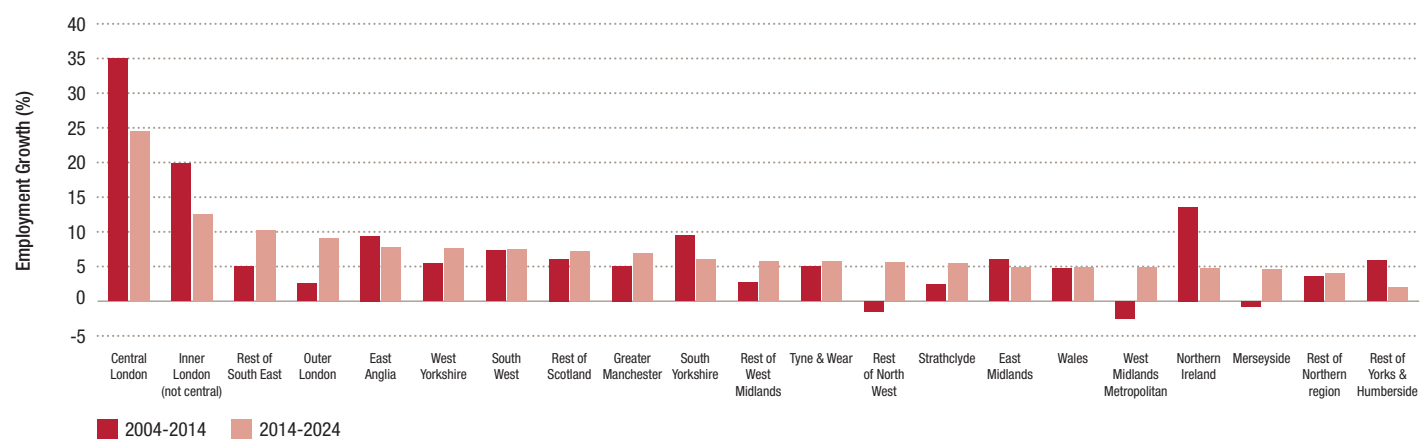
explain about 50 percent of the variation in employment growth across UK regions over the last decade. Using this estimated relationship, we can also make illustrative projections of employment growth over the next 10 years, based on each region's share of workers in new types of jobs in 2014.¹⁴

According to our illustrative projections (Figure 4.5), Central London seems likely to experience the fastest employment growth (of around 25%) over the next decade, though this would be markedly less than the 35% total growth rate over the past decade. This is followed by Inner London (around 12.5% but also decreasing relative to the past decade), the Rest of the South East (10% and rising) and Outer London (9% and rising). Our estimates also show, however, that some regions

outside London and the South East show accelerating employment growth over the next decade as compared to the previous decade. These include West Yorkshire (perhaps reflecting the influence of Leeds), Greater Manchester, the West Midlands and Merseyside. Northern Ireland, by contrast, sees some 'reversion to the mean' in its projected employment growth.

Our projections are subject to many uncertainties, but they generally support the view that skilled cities like London, Oxford, Cambridge, Leeds, Manchester and Edinburgh will continue to be key motors of jobs growth, both in digital areas and more generally across the economy. This is consistent with the findings of other previous PwC research.¹⁵

Figure 4.5: Projected employment growth across UK regions, 2014-24, as compared to past decade



Source: ONS Labour Force Survey; calculations by Carl Frey

¹⁴ These projections are calibrated based on the top-down assumption that total UK employment will grow at an annual rate of 0.7% over the next decade, based on trends in working age population growth and employment rates. The projection does not take explicit account of the potentially expanding scope of job automation (Frey and Osborne, 2013) or other factors, which is why we describe them as only being illustrative.

¹⁵ PwC Good Growth for Cities (2014).

4.5 Fostering new job creation: Implications for policy

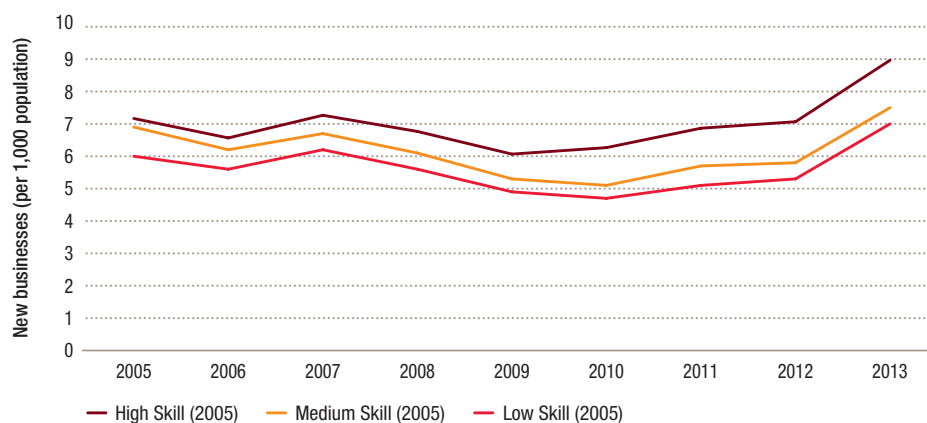
In terms of new job creation, London has been the largest single regional motor of the UK economy. While other regions are catching-up, as new work diffuses from London across the UK, our findings imply that new work initially clusters to take advantage of knowledge flows across companies and industries. Our findings speak to a growing body of research showing that new occupations and industries emerge in skilled cities.¹⁶ Larger pools of skilled workers attract start-ups and knowledgeable workers are more adaptable to technological change.

This is also confirmed by new PwC research for this report. As shown in Figure 4.6, high skill cities (as measured by the proportion of those aged 25-64 with education levels of NVQ3 or above) in the UK have systematically outperformed other cities in terms of new business creation since 2005.

Furthermore, UK cities with a high fraction of skilled workers in 2005 experienced much lower levels of unemployment increase during the recession and subsequently up to 2013 (Figure 4.7) according to other recent PwC research for this report. Skilled workers seem to be more able to shift into new types of work, though the educational measure used here may not pick up all of this effect, which could be more specifically related to levels of cognitive skills that are particularly important in digital sectors and other professional and technical occupations.

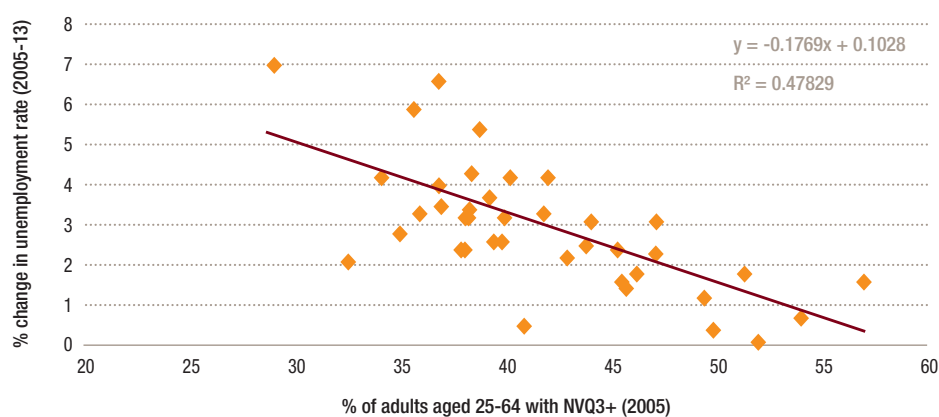
Taken together, these findings have important implications for new job creation in the UK. As the largest

Figure 4.6: New business creation according to average education levels in UK cities



Source: PwC analysis of ONS data

Figure 4.7: Unemployment changes by city in 2005-13 relative to initial education levels



Source: PwC analysis of ONS data

proportion of new work is initially created in London, and then diffuses throughout the UK economy, policies to support further growth of London are important. At the same time, there is a need to support further other clusters of skilled occupations and industries

elsewhere in the UK, as many LEPs and the City region devolution programme have sought to do in recent years.¹⁷

Instead the role of policy should be to create and maintain the soft and hard infrastructure that facilitates job

¹⁶ Berger and Frey (2014a; 2014b); Duranton and Puga (2001); Lin (2011).

¹⁷ The gains from creating strong industry clusters outside London are discussed further in McKinsey and Centre for Cities (July 2014) *Industrial Revolutions* and also by Sentance (2014).

creation and regional diffusion. Universities can play a vital role in fostering new job creation. Since Fredrick Terman, the dean of Stanford's Engineering School, encouraged two of his students, William Hewlett and David Packard, to found Hewlett-Packard (HP) in 1938, Stanford alumni alone have created 39,900 companies and about 5.4 million jobs.¹⁸ London's leading position in new work is similarly likely to be associated with its universities. According to QS World University Ranking, 4 of the top 10 universities for computer science and information systems in the UK are located in London. The other top 10 ranked universities outside London include the University of Southampton, Cambridge, Oxford, Birmingham, Manchester and Edinburgh. The latter three are outside the South East and could provide useful hubs for future development of digital hubs in the Midlands, the North West and Scotland.¹⁹

As the dissemination of knowledge and skills provides the most important force of convergence, investing in education is therefore crucial for regions to catch up and remain resilient to technological change.²⁰ Policy focused on promoting further investment in education and collaboration between universities and digital businesses across regions would help to make regions more adaptable and receptive to the arrival of new technologies.

Second, there is a need to provide the hard infrastructure to facilitate the diffusion of new work across regions, while making sure that the growth of London is not constrained by the supply of housing and transport. According to our estimates, employment in Central London could grow by a further 25% over the next decade. Crucially, as skilled cities are becoming

more attractive, rising house prices makes them less affordable places to live²¹. This has implications particularly for low-income workers, who can often not afford to move or travel to places where new employment opportunities are being created.²² Furthermore, housing constraints in London can also provide constraints on growth for the UK economy as a whole. For example, a recent study estimates output in the United States was 13 percent below its potential over recent decades as a result of insufficient housing in skilled cities.²³

To avoid such an outcome, investment in improving the connectivity between places will be essential to make sure that new job creation continues to thrive in London, while diffusing faster to other regions. In particular, there should be increased attention to building affordable housing outside the city, with faster, less congested commuting links to central London. Doing so will be vital to avoid holding back the growth prospects of the city. In addition, other key cities such as Manchester, Leeds and Liverpool also need improved transport links to support their growth and deliver the government's vision of a new 'Northern powerhouse'.

4.6 Summary and conclusions

Between 2004 and 2014, UK regions showed some convergence in terms of the pace with which they were creating new types of jobs that did not exist in 1990, notably but not only in the digital area. This convergence, however, reflects a general slowdown in the creation of new types of jobs over the past decade: a tendency that is not particular to the UK economy. In the United States, for example, rates of technology-related new job creation have declined over the past

decade, speaking to a growing concern that the digital age of the 21st century has created relatively few employment opportunities compared to earlier waves of new technology, including the personal computer revolution of the 1980s.

Central London continues to lead other UK regions with a share of almost 10% of its workforce in 2014 in new types of jobs that did not exist back in 1990, relative to a UK average rate of around 6%. Our findings support the general trend of new types of jobs clustering in skilled cities, including not just London but also places like Oxford, Cambridge, Manchester and Edinburgh.

Our illustrative model projections suggest that total employment in Central London could grow by around a quarter over the next decade, although this would be slower than the 35% growth rate seen over the past decade. A key task for future UK and London governments will be to make sure that the city's growth potential is not constrained by lagging housing and transport infrastructure.

At same time, our projections do suggest an acceleration of employment growth in some regions outside London, including Greater Manchester, West Yorkshire, the West Midlands and Merseyside. This is encouraging, and reflects our expectation that there will be a continued diffusion of the digital revolution (and other technological advances) across the UK over the next decade. However, this does require increased investment in transport connectivity in these regions, as well as the development of regional clusters around high quality regional universities. Only in this way will the full potential benefits of digital be felt across the country.

¹⁸ Easley and Miller (2012).

¹⁹ As discussed also in Sentance (2014)

²⁰ Piketty (2014).

²¹ See, for example, the discussion in PwC's last Good Growth for Cities report (2014a).

²² Anderson et al. (2014).

²³ Moretti and Chang-Tai Hsieh (2014).

Technical Appendix A

Data and Methodology

To identify the appearance of new types of jobs, we used revisions of the Alphabetical Index of Occupations, maintained by the US Census Bureau. Each index (1990, 2000, and 2010) reports approximately 30,000 occupational titles that are used to identify US census respondents' occupation. Importantly, these indexes are periodically updated to reflect the appearance of new types of jobs in the labour market. New job titles reflect, for example, the appearance of new technologies (e.g. solar PV installer) or shifts in consumer demand (e.g. sommelier), capturing how the labour market is restructured over time.

We created an algorithm that isolates job titles in the 2010 edition for which there is no match in the 2000 edition. Manually, we then compared each new job title to exclude titles that are simply relabelled, reclassified, separated into multiple categories (e.g. bank cashiers with and without an associate degree) or residual titles (e.g. life scientists\ not specified). We mapped each title that appeared for the first time between 2000 and 2010 to their corresponding US detailed occupational category using crosswalks from the US Census Bureau. To this we add the number of new job titles that appeared between 1990 and 2000, taken from earlier research by Jeffrey Lin (Philadelphia Federal Reserve, 2011).

For each occupational category, we calculated the number of new job titles that appeared between 1990 and 2010. Over this period, 948 new occupational titles appeared (relative to a total number of 30,800 titles in 2010). We then normalised the number of new titles by the number of total titles per occupation in 2010, so that we obtain the fraction of new titles for 469 US detailed occupations (that is, the probability that a worker is employed in new types of jobs). For example, in detailed occupation 104 (Computer Support Specialists), 71% of the occupational titles in 2010 appeared for the first time over the period between 1990 and 2010²⁴.

To map US occupations to their UK counterparts, we began by mapping US occupations to their corresponding ISCO88 codes, again relying on crosswalks from the US Census Bureau. We then used crosswalks provided by the ONS that maps UK SOC 2000 codes to ISCO88 codes. In cases where UK SOC 2000 occupations consist of several ISCO88 codes, we took a simple arithmetic average. From 2011 and onwards, the U.K. occupational data is reported using UK 2010 SOC codes. We therefore used crosswalks to map ISCO88 codes to ISCO08 codes from the ILO that in turn are mapped to UK 2010 SOC occupations using a crosswalk from the ONS that matches ISCO08 codes to their UK 2010 SOC counterparts.

Using data on employed persons aged above 16 by region of work from the ONS, we merged the fraction of new types of jobs per UK occupation to each region, for all occupations for which the ONS provide employment figures. Note that because the ONS reports employment figures using SOC 2000 codes for the period 2004-2010 and SOC 2010 codes for 2011-2014, levels of new job types per region are not strictly comparable between these periods, but we have spliced the data together in a way that minimises inconsistencies over time (as can be seen from the relatively smooth time series between 2010 and 2011 in Figure 4.2).

24 When considering data for 2014 in the UK, we are therefore ignoring new job titles that appeared after 2010, since there is no detailed data available on these more recent new job types emerging between 2010 and 2014.

Technical Appendix B

Regression Analysis

We estimated a simple ordinary least squares (OLS) regression where total regional employment growth between 2004 and 2014 was the outcome (dependent variable) and the fraction of new types of jobs in 2004 in each region was the explanatory variable (Table 4.2 and Figure 4.8).

We found that the proportion of new types of jobs is a highly statistically significant predictor of subsequent employment growth (p-value=0.00) by region. The R-squared of the regression is 52%, meaning that about half of the variation in total employment growth across UK regions in 2004-14 can be accounted for by differences in the initial level of new types of jobs in the workforce in 2004.

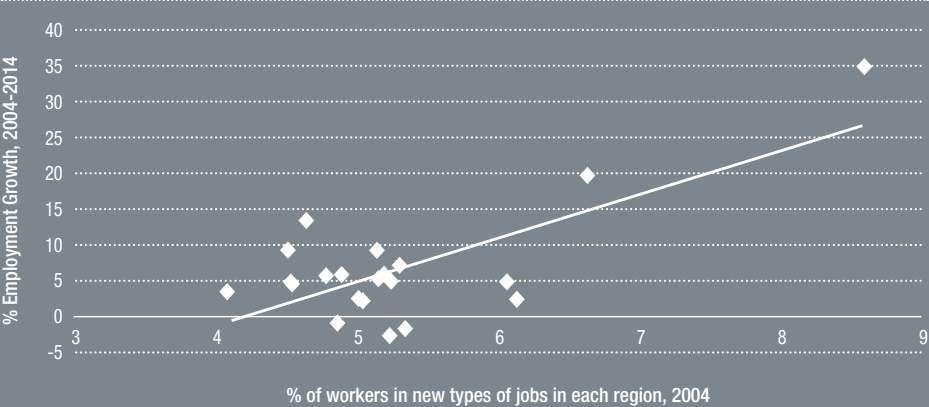
We then fed into this estimated model our data on the proportion of workers in each region in new types of jobs in 2014 and used this to project how total regional employment growth might vary over the coming ten years. However, since these estimates are based on a small sample of regions these results should be interpreted with care. They can only be considered illustrative of potential broad trends rather than being regarded as precise forecasts.

Table 4.2: New Work and Employment Growth in UK Regions, 2014-2024

Outcome: Empl. Growth 2004-2014 (%)	Coef.	Std. Err.	P>t	[95% Conf. Interval]	
New Work 2004 (%)	6.10	1.35	0.00	3.28	8.92
Constant	-25.28	7.20	0.00	-40.36	-10.21
Number of observations				21	
R-squared				0.52	

Source: ONS Labour Force Survey; calculations by Carl Frey

Figure 4.8: Relationship between proportion of workers in new types of jobs in 2004 and subsequent total regional employment growth in 2004-14



Source: ONS Labour Force Survey; analysis by Carl Frey

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Appendix A

Outlook for the global economy

Table A.1 presents our latest main scenario projections for a selection of economies across the world.

We expect the US economy to achieve relatively strong growth in 2015 and 2016. The outlook for the Eurozone economies remains weak in comparison to both the US and the UK, although lower oil prices will help to give the Eurozone some modest upward momentum in 2015-16. In the emerging markets, China's economic growth is slowing down, but remains high in absolute terms. By contrast, the Russian economy is expected to experience a severe economic contraction this year due to a combination of lower oil revenues and sanctions. Significant uncertainties continue to surround global economic prospects with particular risks stemming from the recent problems in Greece and elsewhere in the Eurozone and possible escalation of geopolitical tensions in Russia/Ukraine and the Middle East.

These projections (including those for the UK) are updated monthly in our Global Economy Watch publication, which can be found at www.pwc.com/gew

Table A.1: Global economic prospects

	Share of world GDP	Real GDP growth (%)		Inflation (%)	
	2013 at MERs	2015p	2016p	2015p	2016p
United States	22.4%	3.2	3.1	0.3	1.8
China	12.7%	7.1	7.2	2.2	1.8
Japan	6.6%	1.1	1.4	1.4	2.3
UK	3.4%	2.5	2.3	0.3	1.8
France	3.8%	0.9	1.4	0.1	1.1
Germany	4.9%	1.5	1.9	0.1	1.8
Greece	0.3%	0.7	1.5	0.2	0.3
Ireland	0.3%	3.3	3.2	-1.3	1.0
Italy	2.8%	0.4	1.1	0.4	1.8
Netherlands	1.1%	1.4	1.6	-0.1	1.1
Portugal	0.3%	1.7	1.8	1.2	0.8
Spain	1.8%	2.2	2.2	0.1	0.7
Poland	0.7%	3.3	3.5	-0.3	1.7
Russia	2.8%	-5.0	-0.5	0.1	8.0
Turkey	1.1%	3.5	3.8	15.0	6.5
Australia	2.0%	2.6	3.1	6.7	2.6
India	2.5%	7.0	6.9	2.5	5.2
Indonesia	1.2%	5.8	5.7	4.2	6.7
South Korea	1.7%	3.5	3.7	6.5	2.2
Argentina	0.8%	0.1	3.1	1.5	-
Brazil	3.0%	1.0	2.9	25.0	4.5
Canada	2.4%	2.3	2.2	5.5	1.9
Mexico	1.7%	3.2	3.5	0.9	3.5
South Africa	0.5%	2.0	2.3	3.2	5.6
Nigeria	0.7%	4.2	4.9	5.1	9.9
Saudi Arabia	1.0%	3.2	3.0	11.7	3.0
World (PPP)		3.5	3.9		
World (Market Exchange Rates)	100%	3.0	3.3	2.2	2.4
Eurozone	17.1%	1.2	1.7	0.1	1.4

Source: PwC main scenario for 2015 and 2016; IMF for GDP shares in 2013 at market exchange rates (MERs).

Appendix B

UK economic trends: 1979 – 2014

Annual averages	GDP growth	Household expenditure growth	Manufacturing output growth*	Inflation (CPI**)	3 month interest rate (% annual average)	Current account balance (% of GDP)	PSNB*** (% of GDP)
1980	-2.2	0.1			16.6	0.7	4.1
1981	-0.8	0.3			13.9	1.8	3.3
1982	2.1	1.2			12.2	0.7	2.5
1983	4.2	4.4			10.1	0.3	3.3
1984	2.3	2.5			10.0	-0.5	3.6
1985	3.5	4.1			12.2	-0.3	2.8
1986	3.2	6.5			10.9	-1	2.2
1987	5.5	5.3			9.7	-1.6	1.4
1988	5.9	7.8			10.4	-3.8	-0.7
1989	2.5	4.0		5.2	13.9	-4.3	-0.7
1990	0.5	0.7		7.0	14.8	-3.3	0.7
1991	-1.2	-0.7		7.5	11.5	-1.4	2.8
1992	0.4	1.2		4.3	9.6	-1.6	6.0
1993	2.6	3.1		2.5	5.9	-1.4	7.3
1994	4.0	3.3		2.0	5.5	-0.5	6.2
1995	2.5	2.1		2.6	6.7	-0.7	5.0
1996	2.7	4.2		2.5	6.0	-0.6	3.6
1997	2.6	4.6		1.8	6.8	-0.1	1.7
1998	3.5	4.4	0.4	1.6	7.3	-0.4	-0.1
1999	3.2	5.0	0.5	1.3	5.4	-2.6	-1.2
2000	3.8	5.3	2.3	0.8	6.1	-2.4	-1.5
2001	2.7	3.7	-1.6	1.2	5.0	-2.1	-0.7
2002	2.5	4.0	-2.6	1.3	4.0	-2	1.8
2003	4.3	4.0	-0.6	1.4	3.7	-1.6	2.8
2004	2.5	3.6	2.0	1.3	4.6	-2	3.1
2005	2.8	3.0	-0.1	2.1	4.7	-1.3	3.5
2006	3.0	2.2	2.2	2.3	4.8	-2.2	2.5
2007	2.6	2.8	0.7	2.3	6.0	-2.7	2.7
2008	-0.3	-0.5	-2.9	3.6	5.5	-3.7	4.8
2009	-4.3	-3.3	-9.4	2.2	1.2	-2.8	10.2
2010	1.9	0.5	4.7	3.3	0.7	-2.6	9.1
2011	1.6	-0.1	1.8	4.5	0.9	-1.7	7.0
2012	0.7	1.5	-1.3	2.8	0.8	-3.7	7.6
2013	1.7	1.7	-0.7	2.6	0.5	-4.5	5.9
2014	2.6	2.1	2.7	1.5	0.5	n/a	5.2
Average over economic cycles****							
1979 - 1989	2.7	3.7		7.9	12.2	-0.8	2.4
1989 - 2000	2.3	3.1		3.3	8.3	-1.6	2.5
2000 - 2007	3.0	3.6	0.3	1.6	4.8	-2.0	1.8

* After the revisions to the national accounts data, pre-1998 data is not currently available ** Pre-1997 data estimated *** Public Sector Net Borrowing (calendar years excluding public sector banks)

**** Peak-to-peak for GDP relative to trend

Sources: ONS, Bank of England

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