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*Assessing the impact of bad weather on
business productivity*

An 8x8 Solutions / Cebr report
March 2015



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Foreword

We all love to complain about the weather in Britain but cold, rainy winters have an impact on more than just our moods. Cold snaps cost the UK economy more in lost productivity than any other weather phenomenon, including snow, sleet and floods.

The cost to our nation's GDP is huge. This report reveals that temperatures just one degree centigrade below the minimum average mean GDP is £2.5billion lower across the quarter.

For businesses, this means dips in revenues and slower growth due to the loss of productivity during bad weather. Transport links are impacted, which means employees struggle to commute into work and those that reach the office are faced with a skeleton staff. Medium-sized businesses are some of the worst hit, lacking the same infrastructure of their larger counterparts.

That's why it's vital that companies of all sizes address the issue of business continuity and have a plan in place to combat what the weather throws at them. Using cloud-based technology means staff can work from home, from a café or anywhere with an internet connection and for customers, it's business as usual. Yet only 15-30% of businesses have this technology in place, meaning the majority are unable to carry on if staff are outside of the office.

That's why we're launching this report in advance of Business Continuity Awareness Week 2015, to raise awareness of business continuity and the importance of having a plan in place to deal with any disruption. Cloud technology means companies of any size have access to remote working technology and can safeguard their business against disaster.

Lost productivity can have a devastating effect but with the right technology in place, it's easy to ensure it's business as usual for customers, whatever the weather.

I hope you enjoy reading the full report. If you want to know more, please get in touch at uk-marketing@8x8.com



Kevin Scott-Cowell
Chief Executive Officer of 8x8 Solutions



Executive Summary

This report examines the relationship between weather events and economic growth (measured in terms of gross value added, “GVA”) across the UK’s main industries.

The main findings of this report are:

- Abnormal weather has a significant impact on UK GDP.
- Very cold weather and snow affects the UK economy more negatively than any other weather phenomenon. Since 2005, periods of very cold weather have seen quarterly GDP growth on average 0.6 percentage points lower than typical levels. When minimum temperatures are one degree Celsius lower than average then quarterly GDP is on average £2.5 billion lower.
- The relationship between retail sales and weather is highly dependent on the final product. Food sales tend to decrease with very cold weather due to difficulty in products and customers reaching stores, whilst clothing sales are highly dependent on the mismatch between expected and prevailing weather conditions. Abnormally hot weather at the start of Autumn 2014 led to a sharp falling in clothing sales.
- While some sectors are negatively impacted by adverse weather, other parts of the economy benefit. For example, high levels of sunshine tend to boost growth in agriculture and construction, but hold back growth in the energy sector (as household electricity and gas usage is lower).

- Professional services have to some extent mitigated the impact of staff being unable to reach office sites by using cloud computing. The information and computing sector is leading the way in uptake of cloud based services. Unsurprisingly, then, this sector appears least affected by weather events.
- Agriculture is the most weather dependent sector in the UK.

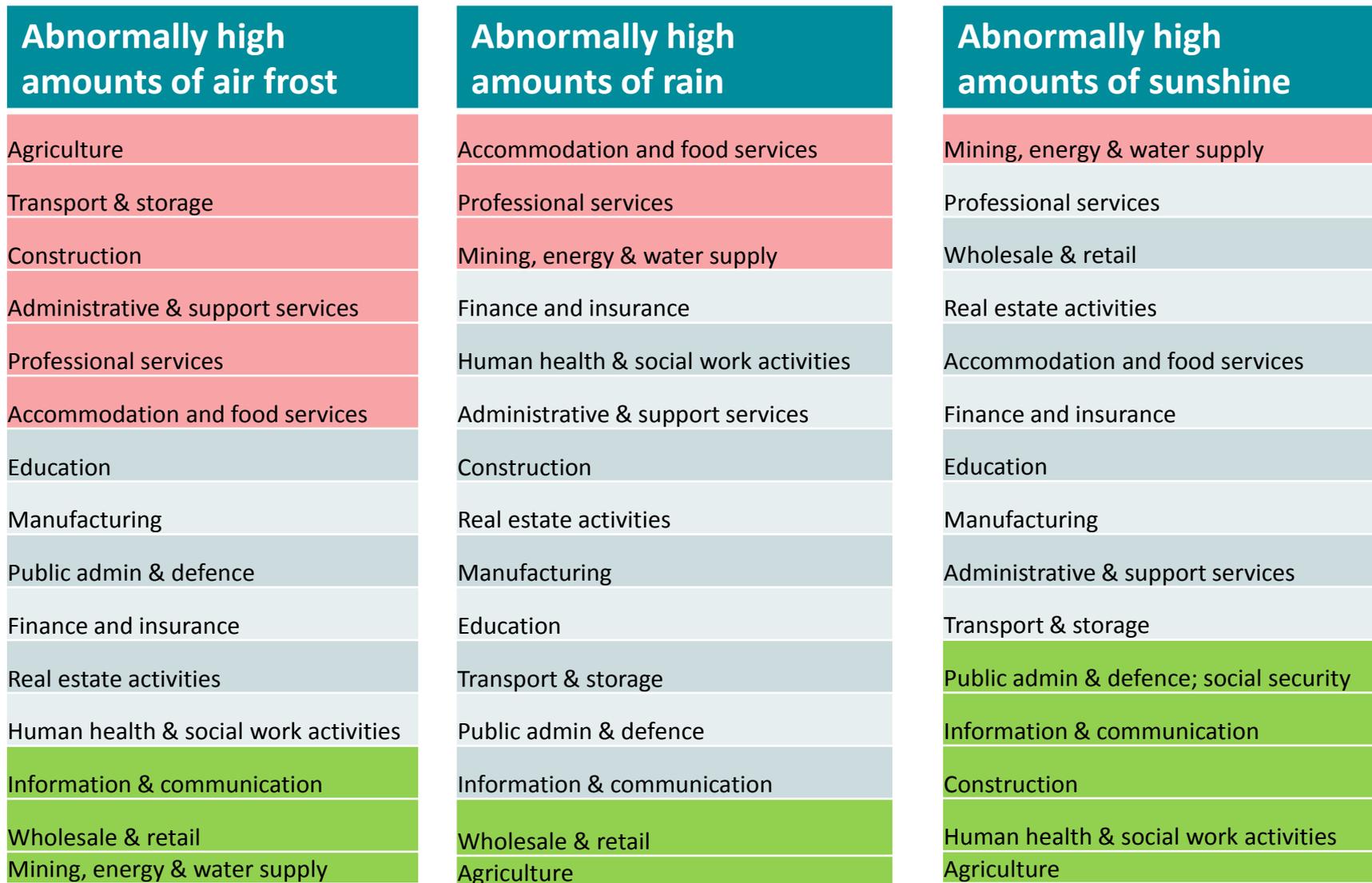
The UK is fortunate to not suffer from frequent extreme weather events, but abnormal or unexpected weather has had a significant impact on the UK economy in recent years.

A few major weather events have been held responsible for knocking the UK economy sharply off course such as the winter of 2010.

Abnormal levels of regular weather events tend to have short term impacts, with businesses making up for lost ground in future time periods. But for some businesses the effects are more sustained. A clothing retailers unable to sell winter clothes due to abnormally warm weather may face a permanent loss of revenue as they are forced to sell stock at a discounted stock. Similarly, flooding can have a permanent negative impact on firms as premises and stock are damaged. Some companies may become insolvent in these circumstances.

Air frost negatively impacts a large number of sectors

Most negatively impacted



Least negatively impacted

= Significant negative impact on GVA growth

= Signs of a positive impact on GVA growth

Very low temperatures have the most negative impact

Most negatively impacted



Abnormally low minimum temperature
Accommodation and food services
Transport & storage
Agriculture, forestry & fishing
Financial & insurance activities
Manufacturing
Construction
Administrative & support services
Education
Professional services
Wholesale & retail
Public admin & defence
Human health & social work activities
Real estate activities
Mining, energy & water supply
Information & communication

Abnormally high maximum temperature
Agriculture, forestry & fishing
Construction
Transport & storage
Public admin & defence; social security
Education
Mining, energy & water supply
Real estate activities
Manufacturing
Financial & insurance activities
Wholesale & retail
Accommodation and food services
Human health & social work activities
Professional services
Administrative & support services
Information & communication

Least negatively impacted



= Significant negative impact on GVA growth



= Signs of a positive impact on GVA growth

Source: Cebr analysis

Extreme cold costs the economy the most

- On average, for each degree Celsius below the average minimum temperature, the cost to the UK economy is a staggering £2.5 billion output lost per quarter. The sector making the biggest loss in £ terms is manufacturing.
- The strongest positive contribution the weather makes to the UK economy is through reduced days of air frost. Each additional frost free day translates into £51 million of extra output per quarter. Professional services gain the most, in part due to better transportation links, another sector which benefits.

For each extra or reduced....	Difference in quarterly GDP during high levels of...	Difference in quarterly GDP during low levels of...
day of air frost	-£ 103m	£ 51m
10mm of Rainfall	-£ 86m	-£ 22m
10 hours of Sunshine	£ 12m	-£ 175m
1 degree (Celsius) Minimum temperature	£ 66m	-£ 2,515m
1 degree (Celsius) Mean temperature	-£ 201m	-£ 1,048m
1 degree (Celsius) Maximum temperature	-£ 89m	-£ 408m

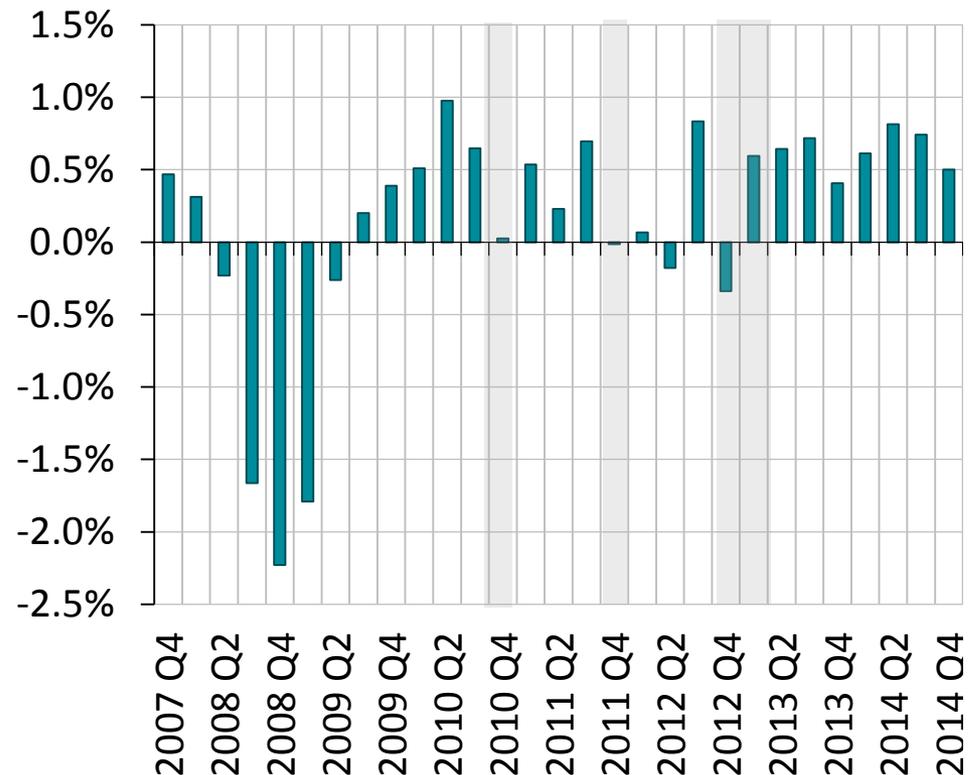
Source: Cebr analysis

Weather and GDP

We know that weather can have a significant impact on GDP

- The weather has had a significant impact on economic growth in recent years, and has been responsible for some of the UK economy's worst quarterly performances since the financial crisis.
- Snow was one of the principle factors blamed by chancellor George Osborne for the UK economy's poor performance in the final quarter of 2010, leading to intense mockery from the opposition.
- The contraction in economic output in the final quarter of 2011 – the first quarterly contraction since the financial crisis – was also attributable to snow.
- Construction output fell by 2.7% and 1.4% quarter on quarter in Q4 2010 and Q4 2011 respectively – major drivers of the economic slowdowns seen in these periods.
- There were fears of a recession at the end of 2012 and early 2013 as poor weather impacted several sectors, but this was avoided as other parts of the economy expanded.

Quarter-on-quarter growth in UK GDP



Source: ONS, Cebr analysis

Cold weather has the greatest impact on GDP – but significant variation across sectors

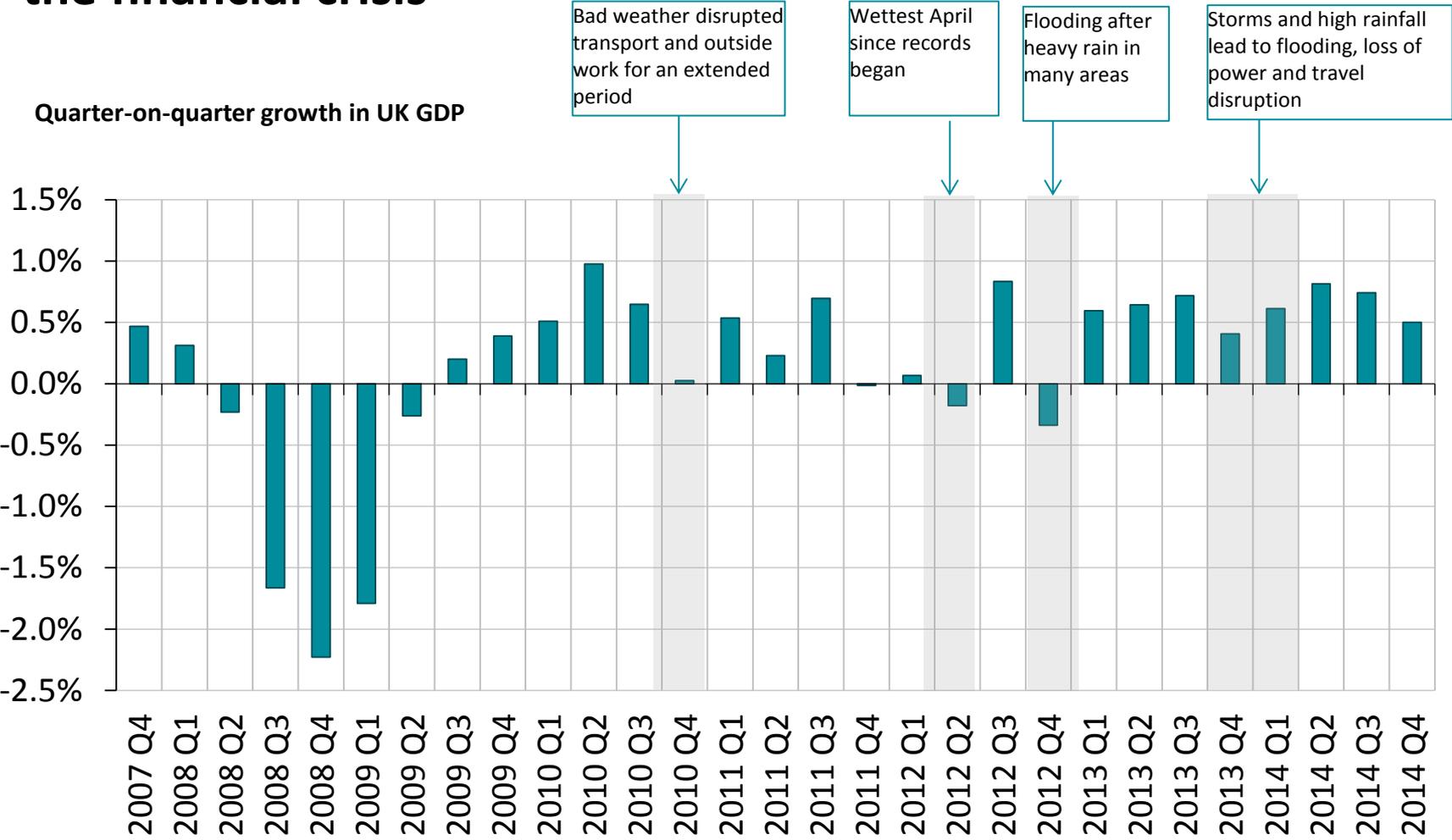
Percentage point change in GDP growth during periods of abnormal weather

- Our analysis of ONS GDP data and Met Office weather statistics show that cold weather has by far the most significant negative impact on GDP.
- Periods in which minimum temperatures have been abnormally low have seen quarterly economic growth rates 0.6 percentage points lower than average.
- Periods of abnormally high levels of air frost or abnormally low levels of sunshine have seen quarterly economic growth some 0.2 percentage points lower than average.
- Underneath these headline findings are significant sector variations, which we examine in the remainder of this report. Indeed, the sector analysis shows that while bad weather can have a significant negative on many industries, some stand to gain from the poor conditions.

	Difference in GDP growth during high levels of..	Difference in GDP growth during low levels of..
Air frost	-0.2pp	+0.1pp
Rainfall	-0.2pp	0.0pp
Sunshine	0.0pp	-0.2pp
Minimum temperature	0.0pp	-0.6pp
Mean temperature	-0.1pp	-0.3pp
Maximum temperature	0.0pp	-0.1pp

Source: Cebr analysis

The UK has suffered several weather-related slowdowns since the financial crisis



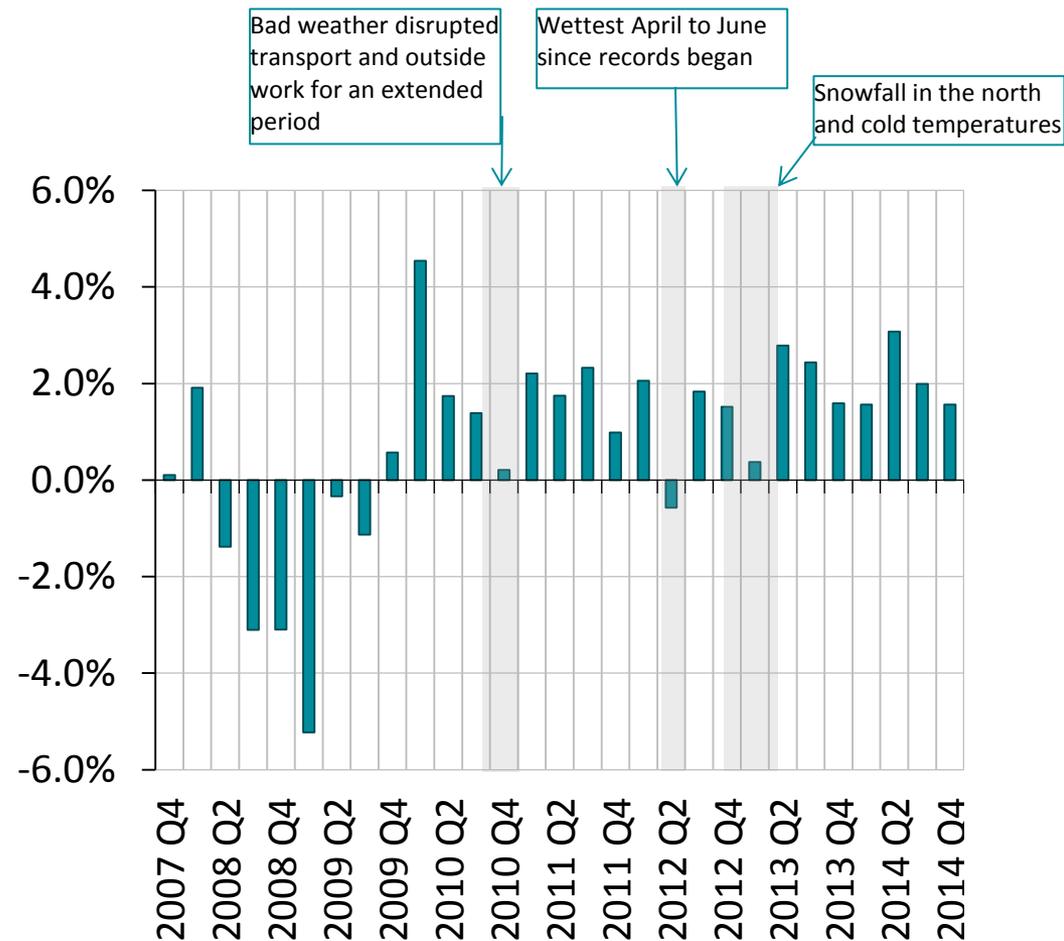
Source: ONS, Cebr analysis

Impact on office-based jobs

Professional services have been impacted by all types of bad weather

- Our analysis of the last decade of economic activity shows that the UK's professional services – both in the public and private sector – continue to struggle with cold snaps.
- The nature of professional jobs means that a period of bad weather could prevent employees from getting to work due to reduced forms of transportation. Those who do get to work on particularly poor weather days often meet a skeleton staff, hindering productivity.
- Many small offices are unprepared for such events as they often lack remote access to their work due to security concerns and a lack of infrastructure. This is compounded in many cases by inadequate internet connections or computing power at staff homes.
- In addition SME's (small and medium sized businesses) tend to suffer more than their larger counterparts who can spread the setup and maintenance costs of remote working infrastructure across many more staff.
- Due to the nature of the 'damage' caused by the bad weather periods the impact of such occurrences is short lived and GVA growth can be seen to rebound in the subsequent periods.

Quarter-on-quarter growth in professional activities GVA



Source: ONS, Cebr analysis

Very low temperatures freeze growth in the professional sector

Percentage point change in GVA growth due to abnormal weather

	Impact of abnormally high levels on quarterly professional sector growth	Impact of abnormally low levels on quarterly professional sector growth
Air frost	-0.5pp	+0.8pp
Rainfall	-0.7pp	-0.6pp
Sunshine	+0.0pp	-0.5pp
Minimum temperature	+0.7pp	-0.6pp
Mean temperature	+0.1pp	-0.4pp
Maximum temperature	+0.3pp	-0.4pp

- Higher than average minimum temperatures and lower than average levels of air frost is associated with the greatest boost to the professional sector. Whilst the opposite weather conditions are a drag on the sector.
- The change in GVA during extremes of rainfall, i.e. flooding or droughts, is negative in both cases. This maybe because flooding disrupts transportation services and causes damage to buildings and personal property, meanwhile droughts are linked to hot weather when again transportation systems are put under strain and there are higher levels of air pollution.

Source: Cebr analysis

Cold weather is costly for the professional services sector

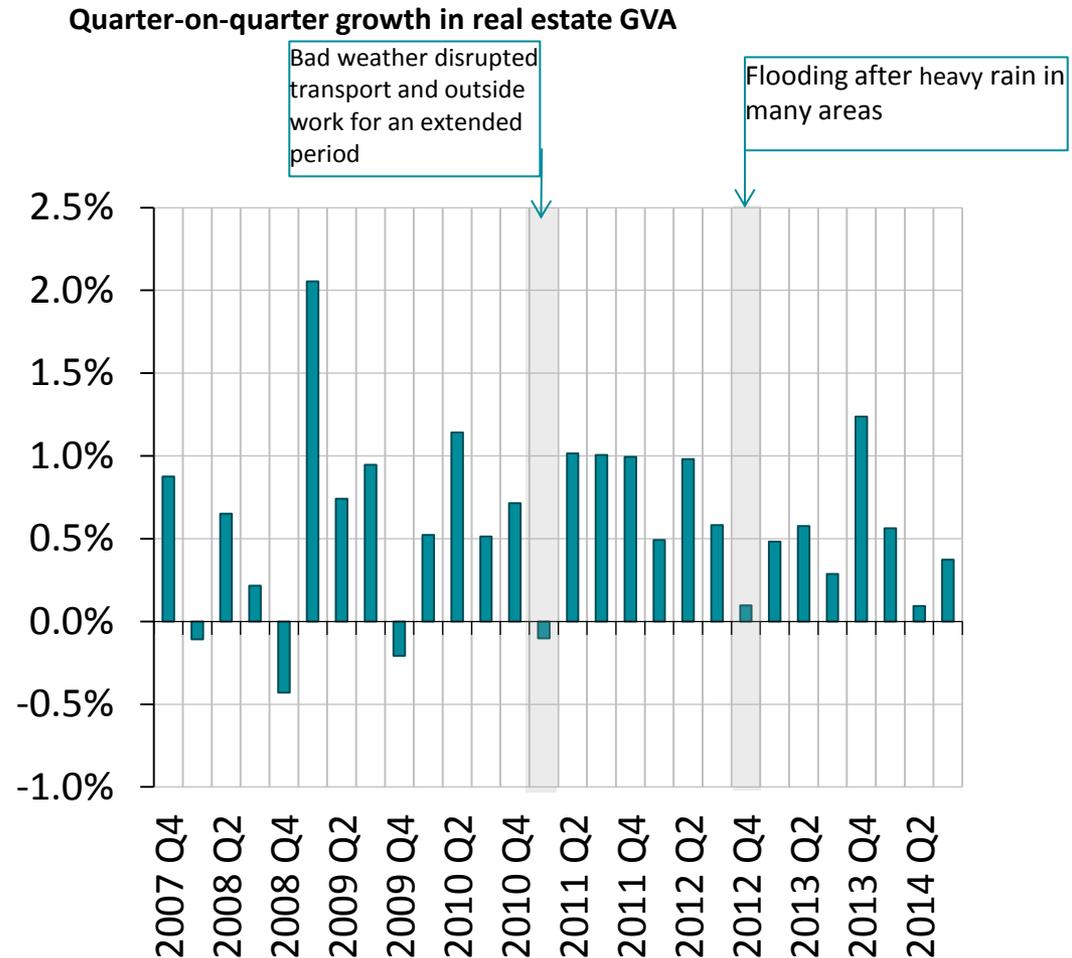
- When the minimum temperature is higher than average this is associated with a boost to the professional services sector of £130m, the largest positive contribution of any weather type.
- Meanwhile the most expensive type of weather for the professional services sector is cold temperatures. The cost associated with the temperature being 1 degree below the average minimum temperature is £191m.

For each extra or reduced....	Difference in quarterly GVA during high levels of...	Difference in quarterly GVA during low levels of...
day of air frost	-£ 18m	£ 26m
10mm of Rainfall	-£ 28m	-£ 21m
10 hours of Sunshine	£ 2m	-£ 29m
1 degree (Celsius) Minimum temperature	£ 130m	-£ 191m
1 degree (Celsius) Mean temperature	-£ 20m	-£ 118m
1 degree (Celsius) Maximum temperature	-£ 54m	-£ 101m

Source: Cebr analysis

Real estate is more sensitive to extreme rather than regular weather

- In our analysis economic growth in the real estate sector was not strongly correlated with high or low levels of 'regular' weather events.
- Very cold weather was the only possible cost to the sector as cold snaps often lead to housing problems for landlords and sellers.
- Due to the nature of real estate the sector is much more susceptible to 'extreme' weather events such as the flooding and storms which occurred in November 2012.
- It can be seen from the graph that these extreme weather events only impact the sector for a quarter, after which GVA growth has been seen to jump back in the following period.

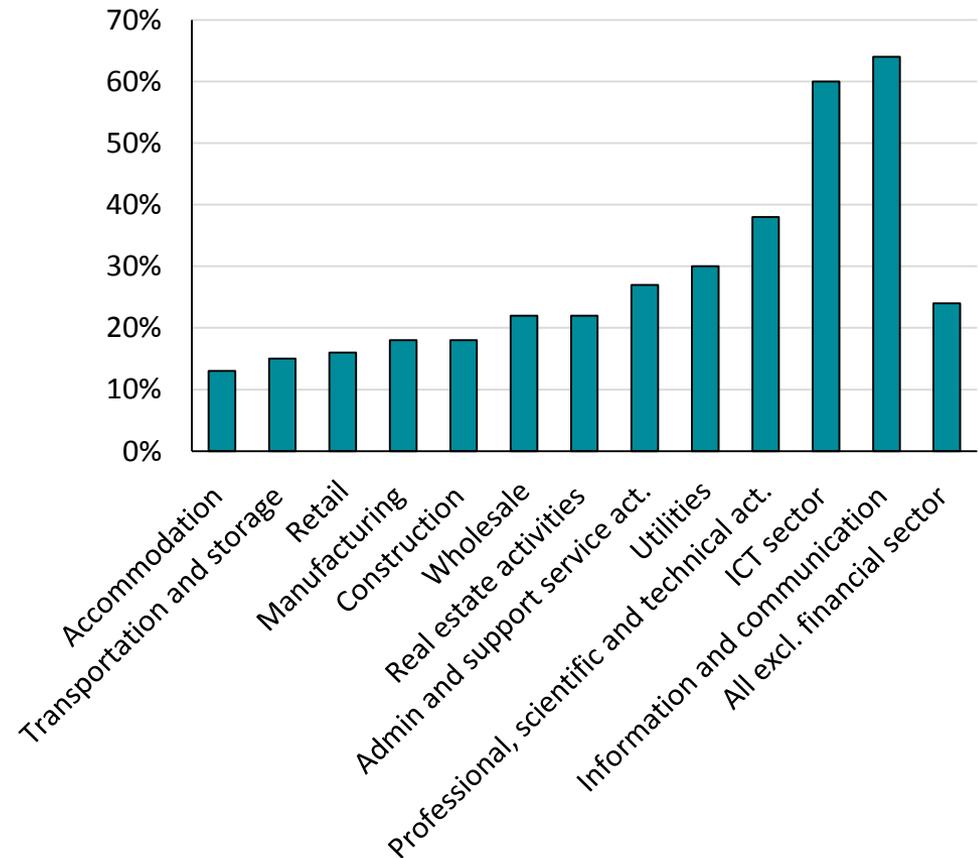


Source: ONS, Cebr analysis

Sectors are using technology to mitigate the impact of adverse weather

- Cloud computing services allow companies to mitigate the impact of weather in a variety of ways.
- The Information and communications sector has been the most active in taking up this technology, whilst the proportion of businesses of other sectors hover between 15-30%.
- Offices have been using cloud computing systems to allow staff to work remotely when bad weather hits key transportation links, meaning that weather can have a reduced impact on employee productivity.
- Transport businesses have been using technology such as satellite navigation to avoid weather-created traffic problems for over a decade.
- Groups such as Federal Express, a courier services company, have their own in-house metrological team. Their task it is to spot weather problems so the business can then take the appropriate action to work around the weather event.
- Gritit, a gritting company, has been using cloud computing software to direct vehicles to the roads which are the highest priority by combining localised weather predications in their cloud based software to identify the key routes.
- Commuters now use mobile travel apps to check for delays and calculate alternative routes to work.

Proportion of businesses with 10 or more people buying cloud computing services over the Internet, by industry sector, 2014

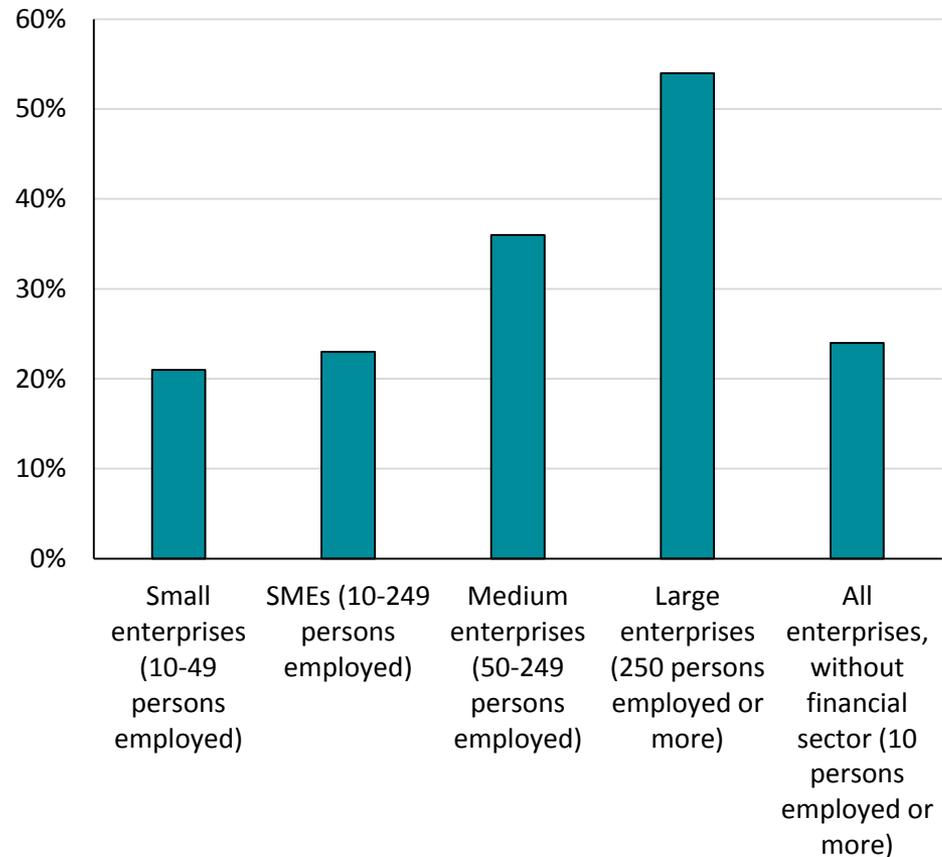


Source: ONS, Eurostat, Cebr calculations

The smaller the firm the lower the uptake of cloud computing

- Many small offices are unprepared for such events as they often lack remote access to their work due to security concerns and a lack of infrastructure.
- This is compounded in many cases by inadequate internet connections or computing power at staff homes.
- In addition SME's (small and medium sized businesses) tend to suffer more than their larger counterparts who can spread the setup and maintenance costs of remote working infrastructure across many more staff.

Proportion of businesses with 10 or more people buying cloud computing services over the Internet, by firm size, excluding the financial sector, 2014



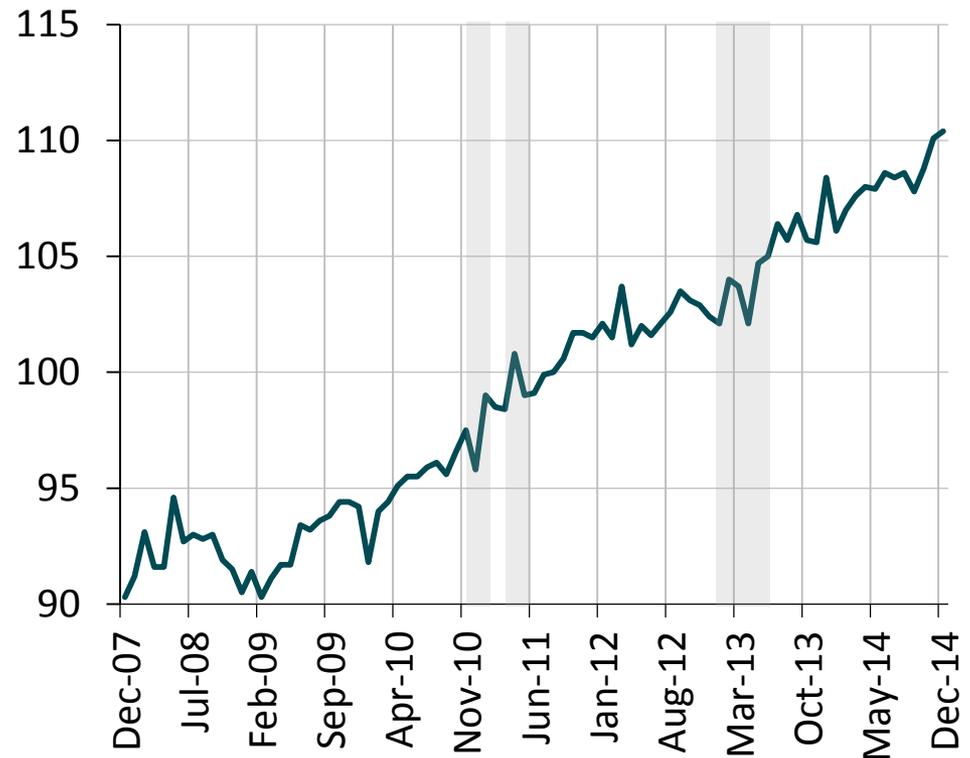
Source: Eurostat

Impact on retail

The impact of weather on retail is mixed, varying across store categories and the time of the year

- The weather has a complicated effect on retail sales, affecting different goods at different times of year. For example, retail sales increased during warm weather in March 2012 and decreased during cold weather in March 2013, but this is often further complicated by other factors.
- Despite the rise of online shopping, retail sales appear to have become more weather-sensitive in recent years compared with before the financial crisis. This possibly reflects an increased variability in spending, which may reflect (until recently) less secure consumer confidence during and after the 2008/9 economic downturn.
- June-July 2007 saw rainfall close to double the long-term average for the time of year across most of the UK, and tens of thousands of homes and businesses were flooded towards the end of July. However, retail sales remained resilient.
- December 2010 saw severe cold weather. Retail sales fell significantly, and there was a corresponding increase in January 2011 despite a VAT increase in that month.
- April 2011 saw mean temperatures 3.7°C higher than the average for the time of year, more than any other month since 2003. Feedback from retailers in food stores suggested that both of these factors contributed to their increased sales, but retailers in non-food stores suggested that only the weather was a contributing factor.
- March 2013 was the coldest March since 1962, and also saw significant snowfall. Retail sales fell significantly.
- Different types of retail store – such as supermarkets and clothing stores – are impacted by the weather in different ways.

Index of UK retail sales values (2011 = 100)



Source: ONS, Cebr analysis

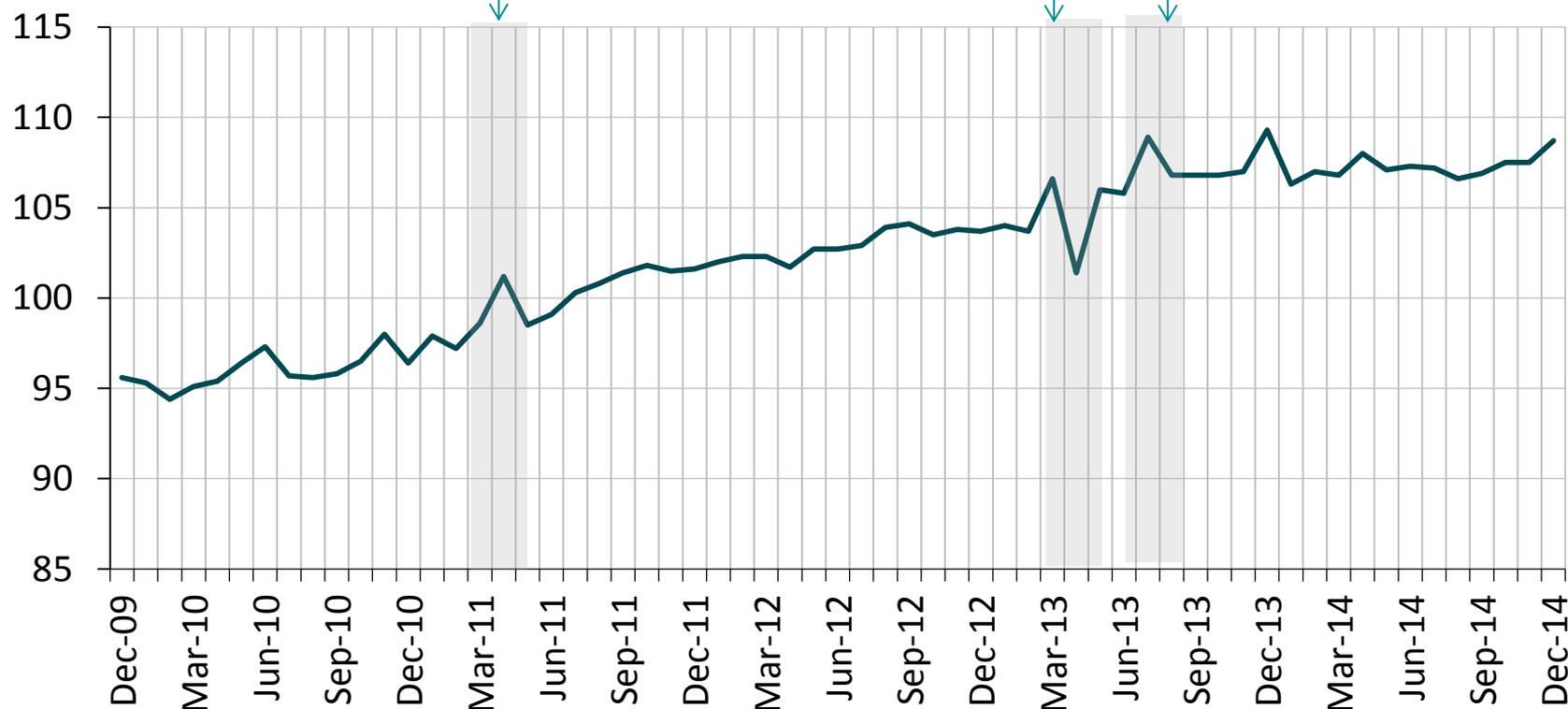
Supermarket sales are affected by weather trends...

April 2011 - warm weather and Royal Wedding boost sales

In April 2013, cold weather impacted sales. In particular, the weather hindered sales within supermarkets' spring and summer ranges, including barbecue items and garden furniture.

Feedback from supermarkets suggested that sunny weather in the summer of 2013 boosted sales across a range of products including food, alcohol, clothing and outdoor items.

Index of predominantly-food store retail sales (2011 = 100)



Source: ONS, Cebr analysis

... as are clothing sales

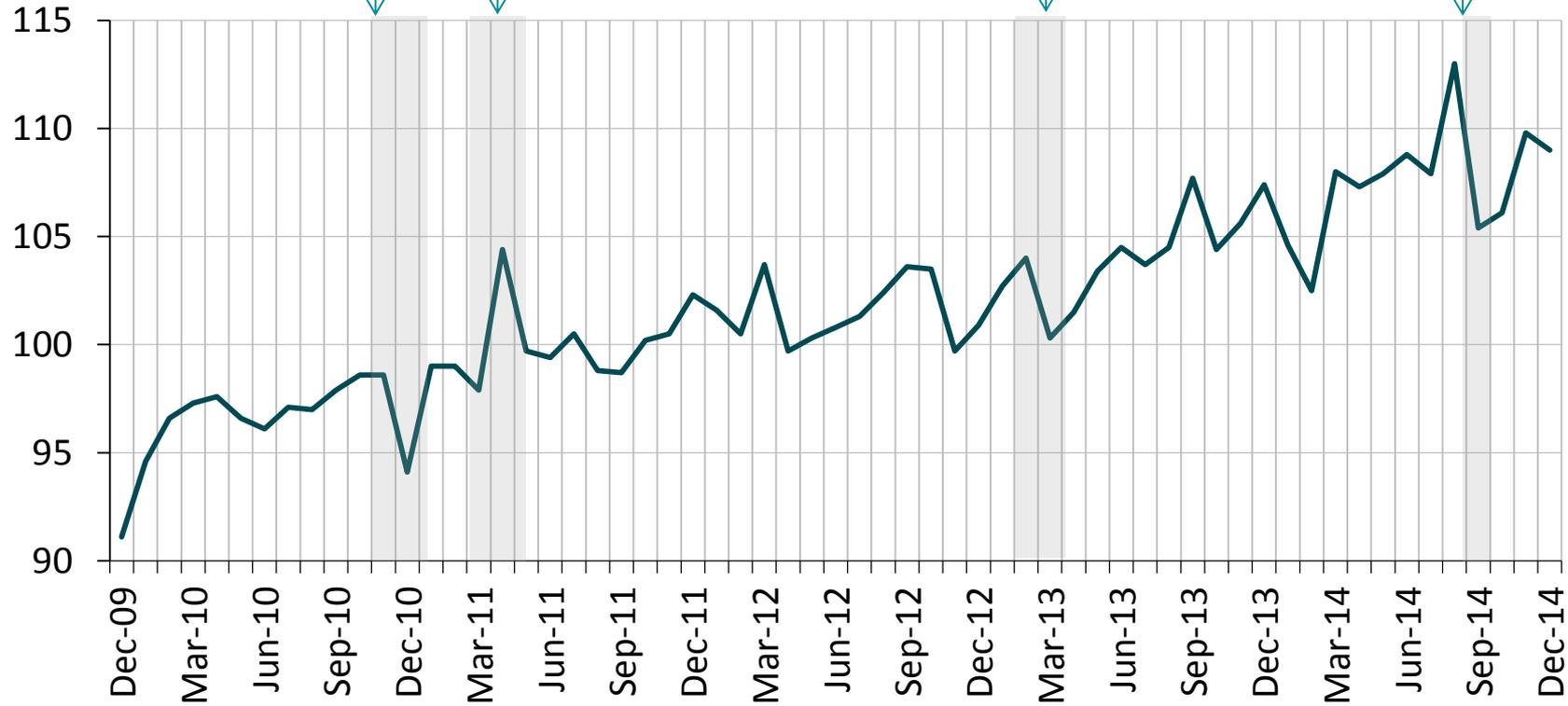
Cold weather at end of 2010 impacts clothing purchases

Warm weather and Royal Wedding boost sales

March 2013 was the coldest March since 1962 and also saw significant snowfall

Warm start to Autumn 2014 reduces demand for winter clothing items

Index of predominantly-clothing store retail sales (2011 = 100)



Source: ONS, Cebr analysis

Unusually low of sunshine and very cold weather have the most negative impacts on the retail & wholesale sector

Percentage point change in GVA growth due to abnormal weather

	Impact of abnormally high levels on quarterly wholesale & retail sector growth	Impact of abnormally low levels on quarterly wholesale & retail sector growth
Air frost	+0.5pp	+0.5pp
Rainfall	+0.4pp	-0.2pp
Sunshine	+0.1pp	-0.3pp
Minimum temperature	+0.4pp	-0.5pp
Mean temperature	+0.1pp	+0.1pp
Maximum temperature	+0.2pp	+0.4pp

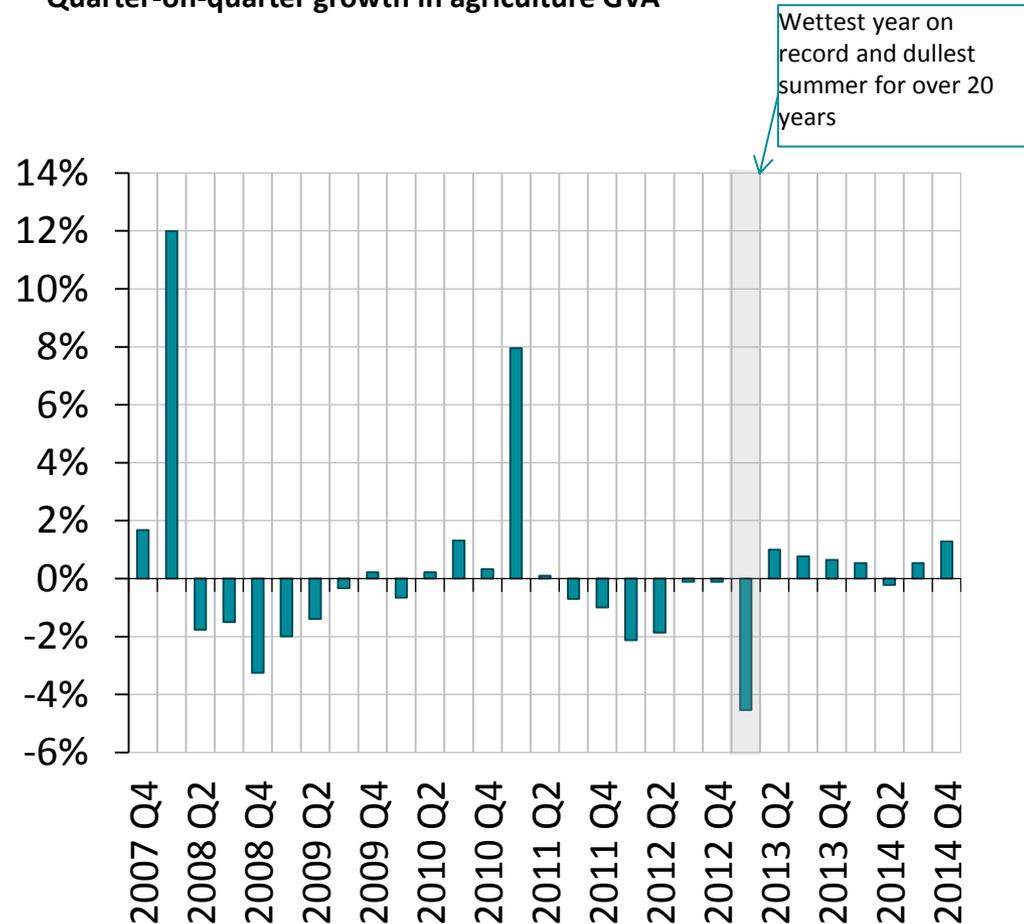
Source: Cebr analysis

Impact on production and agriculture

Agriculture is the most sensitive sector to weather events

- Of all the major sectors examined in this report, agriculture is the most weather-sensitive.
- The agricultural sector has seen quarterly GVA growth 1.4 percentage points higher in periods of abnormally high sunshine levels.
- Lower levels of frost are also associated with higher rates of economic growth in the agricultural sector.
- Climate scientists have said that the initial impact of global warming across the globe was to improve crop yields in the UK. However, if global warming continues this trend is expected to flip, with warmer than average months associated with worse crop yields.
- 2012 was both the wettest year on record and the dullest summer for over 20 years. This combination was followed by the coldest March in 2013 for over 50 years. This unfavourable set of conditions saw agricultural output growth stall in late 2012 and fall dramatically in 2013.
- Evidently the periods of bad or good weather are isolated events and there appears to be no long term impact on GVA growth.

Quarter-on-quarter growth in agriculture GVA

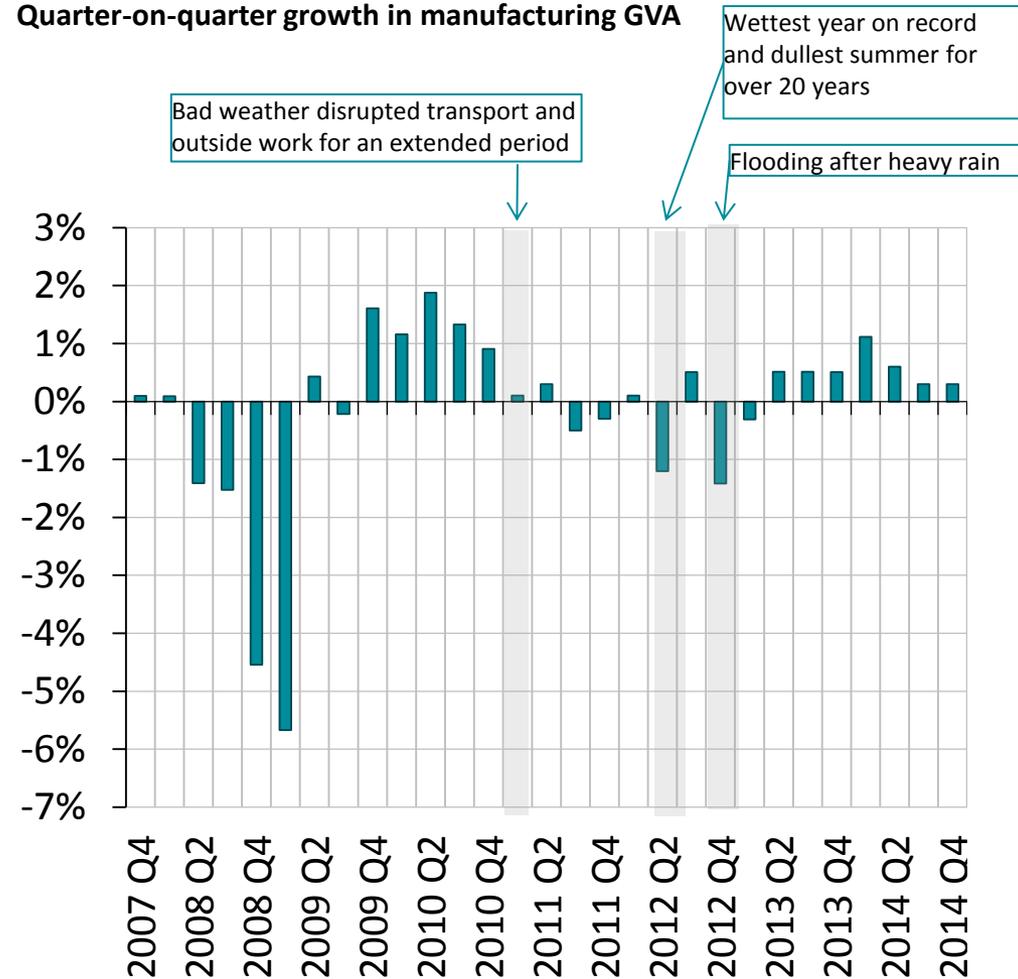


Source: ONS, Cebr analysis

Manufacturing suffers from frost bite and heavy rainfall

- Manufacturing on the whole is largely insensitive to weather changes, though there are likely to be variations within the broad sector.
- High levels of rainfall are associated with flooding which can cause serious problems for the manufacturing sector. For instance, in February 2014 flooding in the Thames Valley, an area of technology and advanced manufacturing, was thought to have affected output in the area.
- Days with higher levels of air frost adversely affect subsectors of manufacturing such as production of wood products and furniture.
- The impact of flooding and frost are twofold on manufacturing as there is a direct impact on lost output and an indirect impact through less effective transportation.

Quarter-on-quarter growth in manufacturing GVA

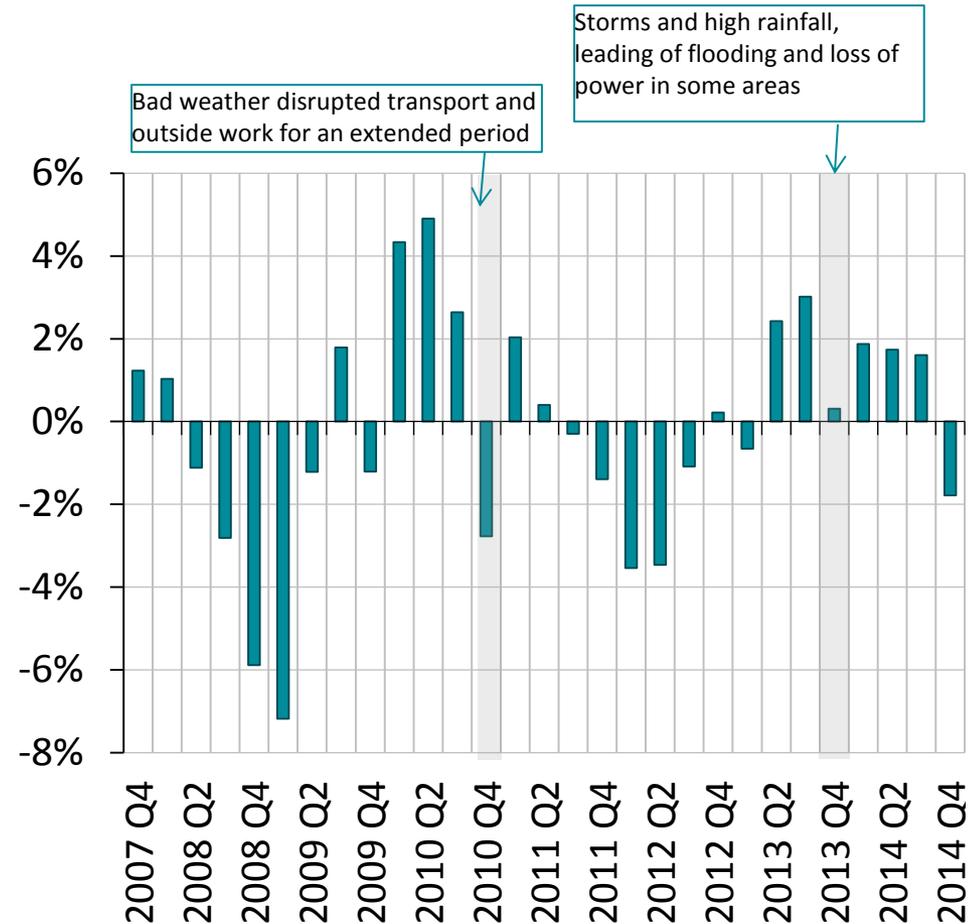


Source: ONS, Cebr analysis

Headlines of a 'double-dip' recession were weather dependent

- Construction work is highly sensitive to the UK's weather. The weather was in the headlines in 2012 for causing output from the construction sector to fall drastically.
- The bad weather of 2012 was to blame for exacerbating an already present slump in the construction sector.
- Estimates of the impact weather has on construction productivity vs output are masked by the sector's fluid labour market which enables workers to be laid off when there is less work available. This means that identifying productivity decreases due to weather events for this sector is difficult. Weather therefore appears to impact output more than productivity in the construction sector.
- Severe frost can temporarily stall sites as certain construction processes are unable to take place.
- Other weather events such as high wind speed and snow have more significant impacts as they and lead to sites stalling due to unsafe conditions.

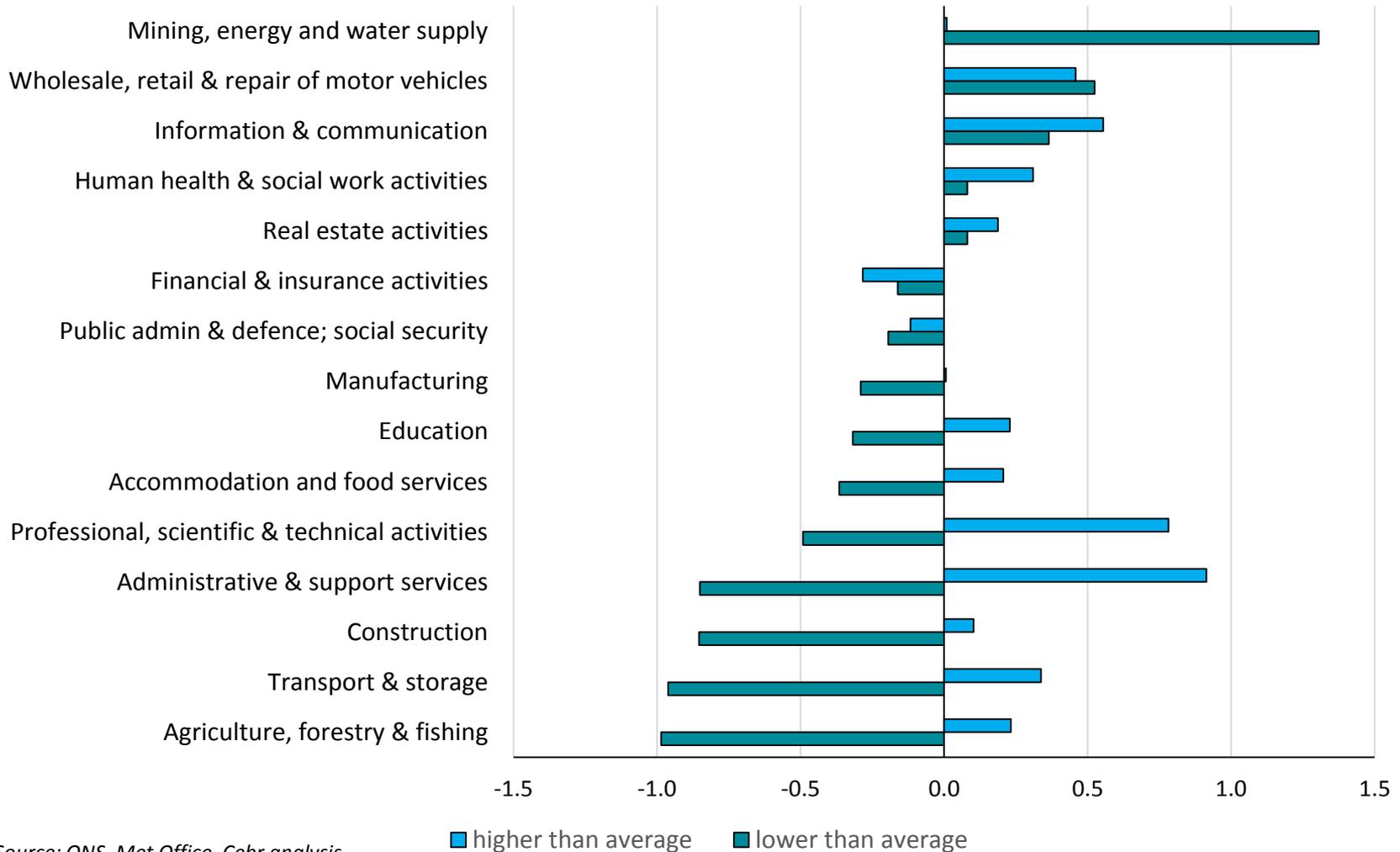
Quarter-on-quarter growth in construction GVA



Source: ONS, Cebr analysis

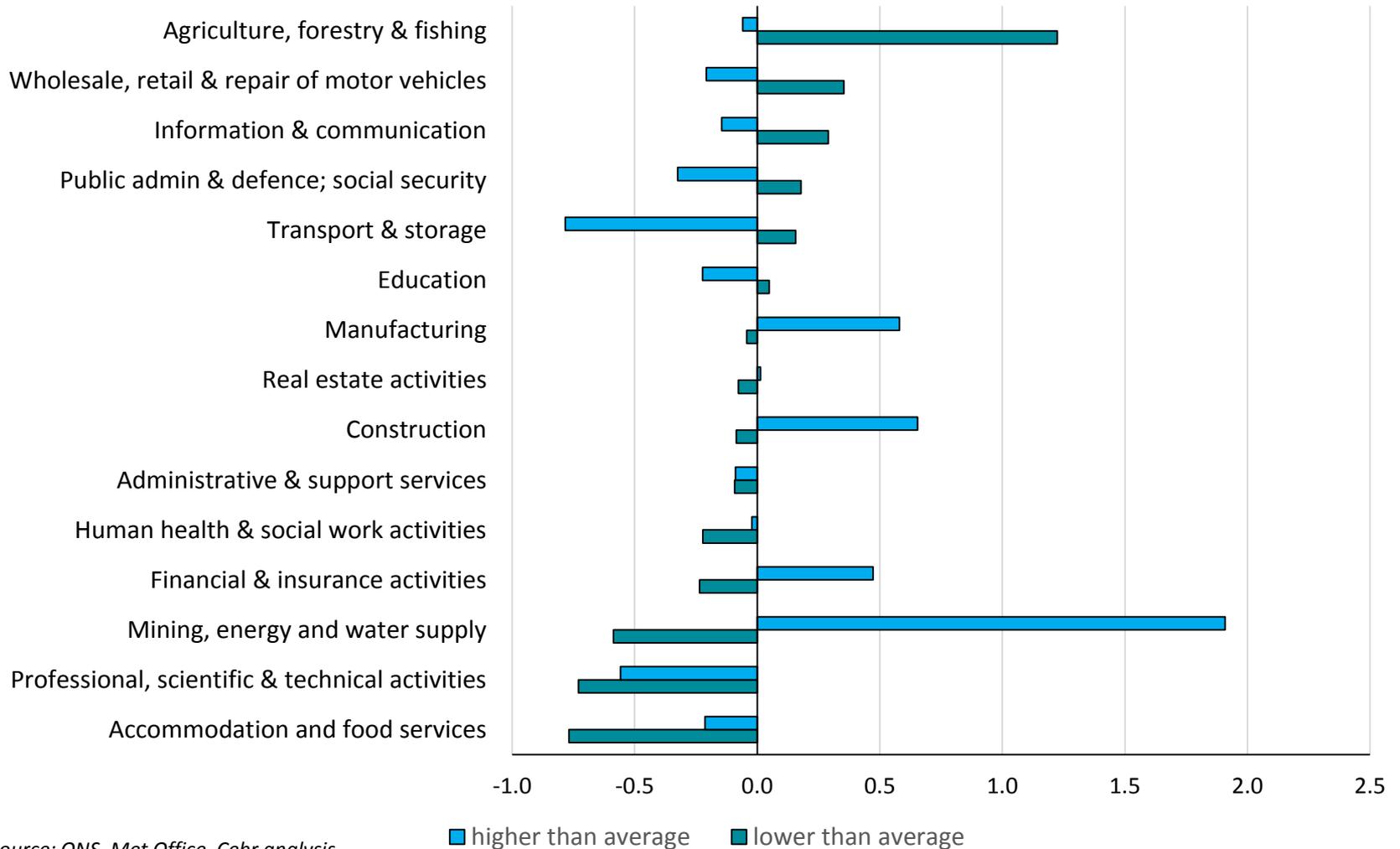
Summary results

Average GVA growth associated with abnormal levels of frost 2005-2014, as percentage point difference from period average



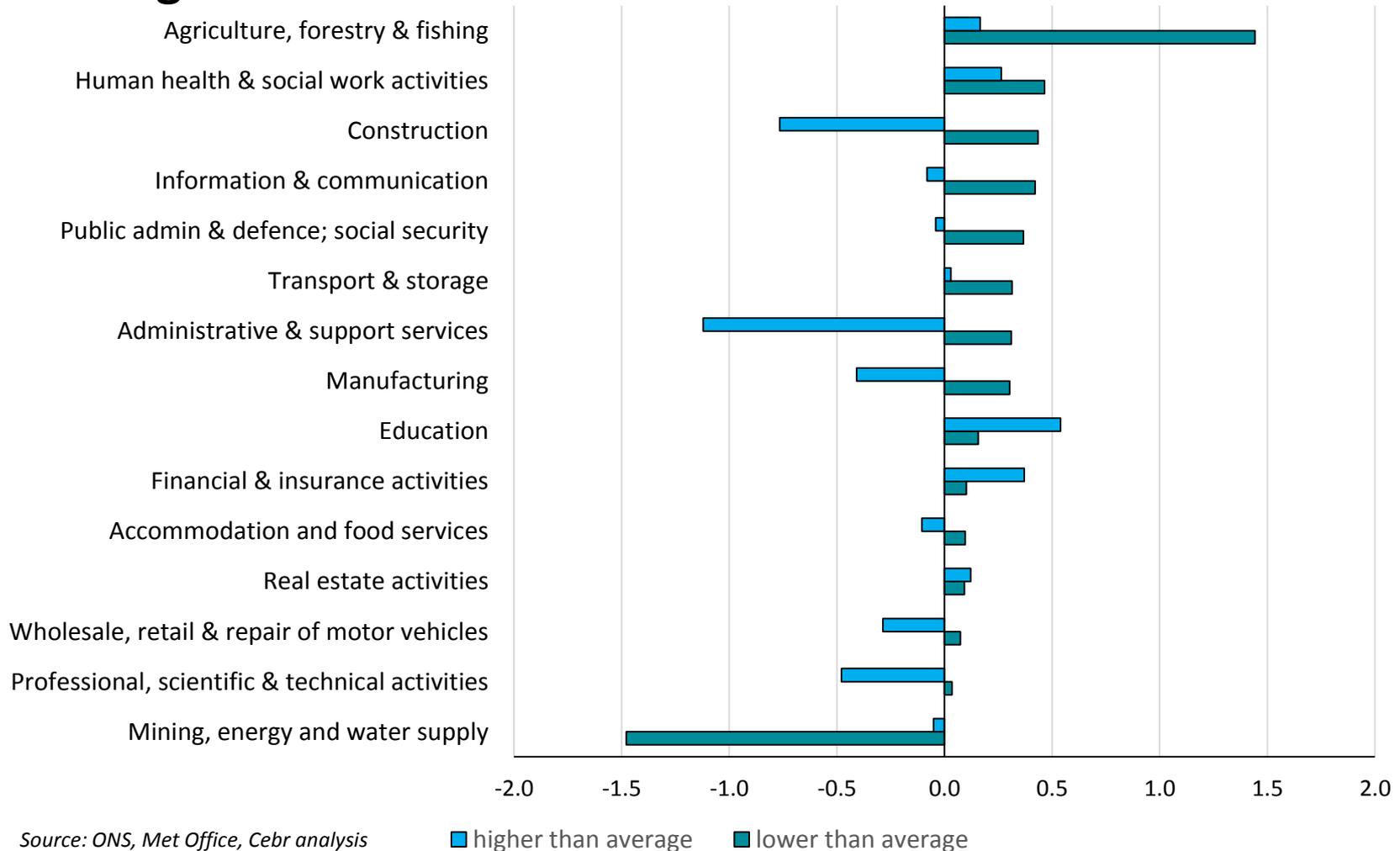
Source: ONS, Met Office, Cebr analysis

Average GVA growth associated with abnormal levels of rainfall 2005-2014, as percentage point difference from period average



Source: ONS, Met Office, Cebr analysis

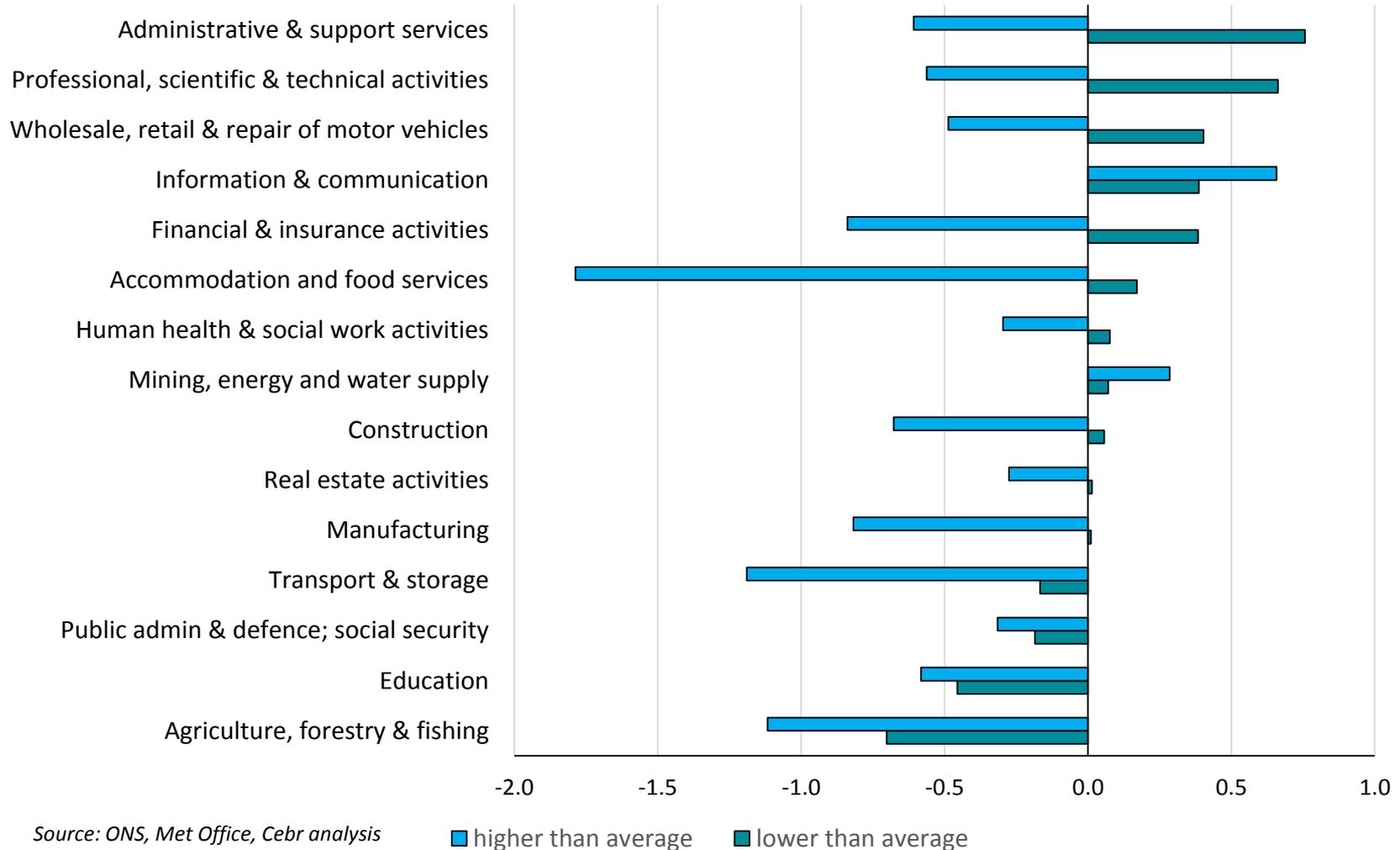
Average GVA growth associated with abnormal levels of sunshine 2005-2014, as percentage point difference from period average



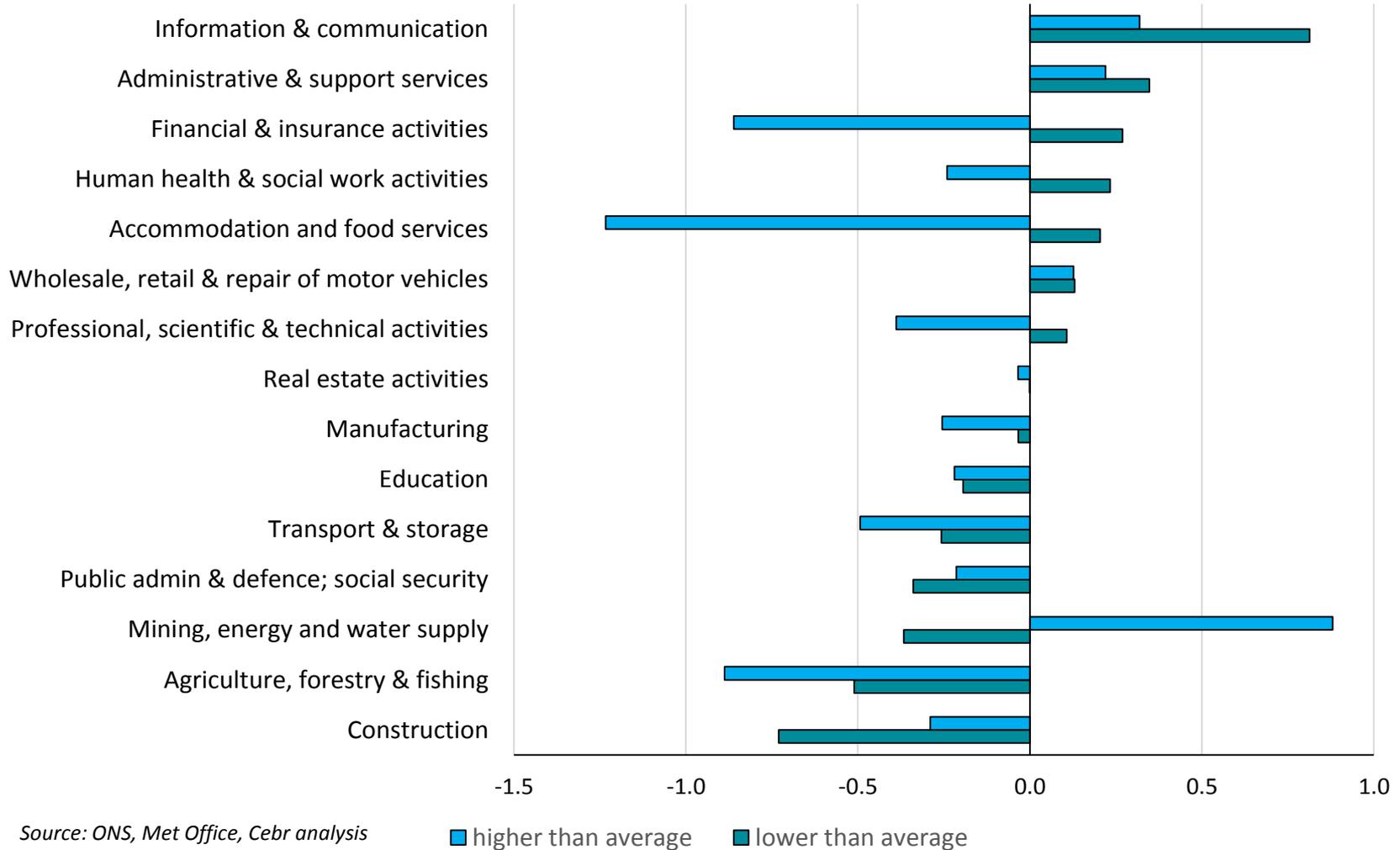
Source: ONS, Met Office, Cebr analysis

■ higher than average ■ lower than average

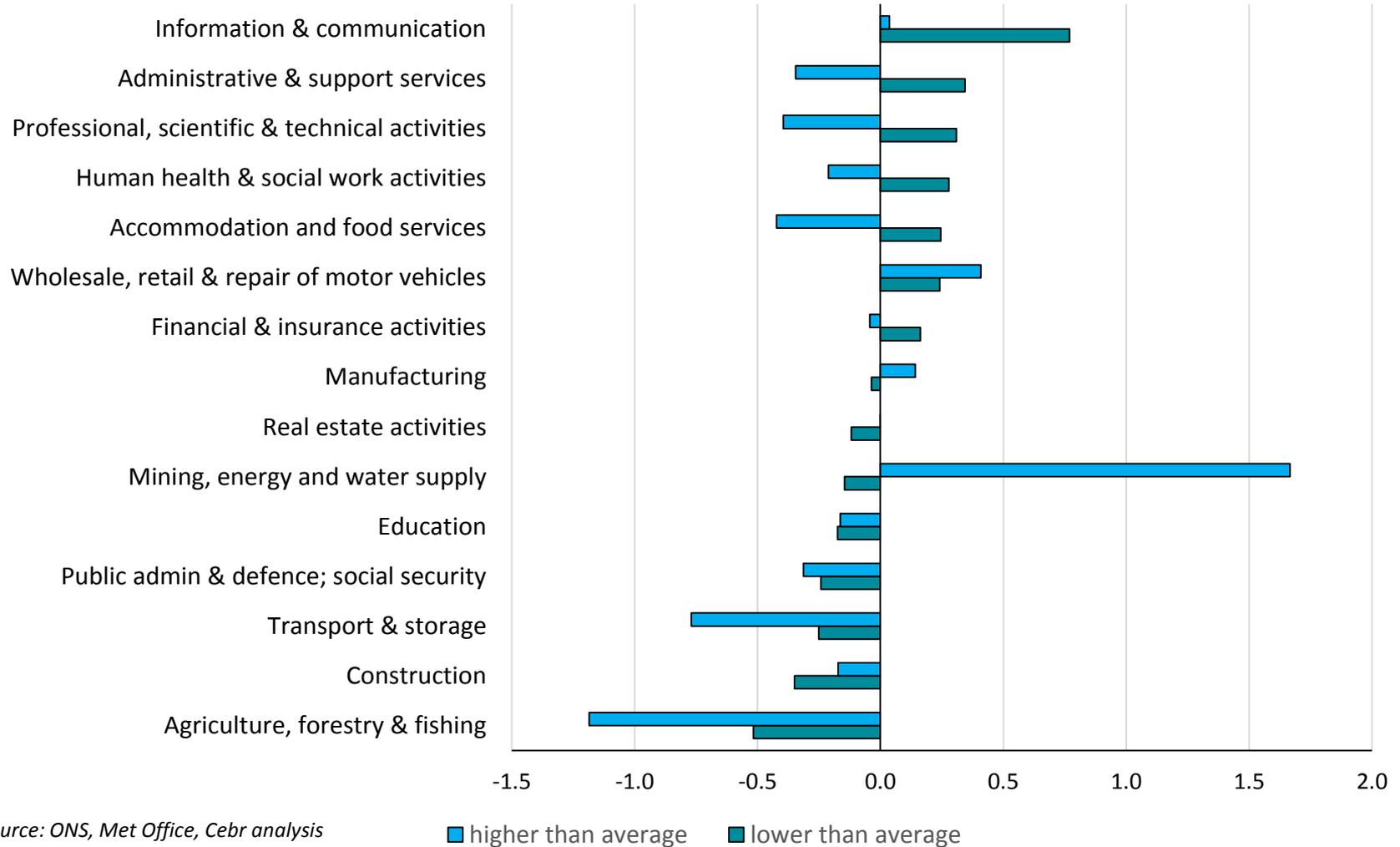
Average GVA growth associated with abnormal minimum temperatures 2005-2014, as percentage point difference from period average



Average GVA growth associated with abnormal mean temperature 2005-2014, as percentage point difference from period average



Average GVA growth associated with abnormal maximum temperature 2005-2014, as percentage point difference from period average



Source: ONS, Met Office, Cebr analysis

■ higher than average ■ lower than average

Methodology

Methodological note

Economic data series

- Economic data was sourced from the ONS national and labour market accounts.
- Several alternative models were tested in the data analysis for this report, including looking at the relationship between weather and:
 - Productivity,
 - Turnover,
 - Gross Value Added (GVA) – a measure of “economic growth” on an industry basis.

The optimal series for this report was found to be quarterly growth rates of GVA.

Seasonally adjusted data was used as this takes account of the impact of **regular** weather changes across the year – allowing us to identify how **abnormal** weather impacts different parts of economy.

Weather data series

- Weather data was sourced from the Met Office.
- Weather data was collected for six types of weather events on a monthly basis:
 - UK Days of Air Frost
 - UK Rainfall (mm)
 - UK Sunshine (Total hours)
 - UK Minimum Temperature (Degrees C)
 - UK Mean Temperature (Degrees C)
 - UK Maximum Temperature (Degrees C)

Methodological note

Indicators

- Indicators were required to identify abnormal weather events and industry values.
- An abnormal weather event was defined as one in which weather was significantly above or below long-term averages for a given month. (More than one point five standard deviations away from the average in statistical terms).

Model

- Several models were test in this report, the optimal model was found to be:
 - Averaging sector economic growth rates in periods of abnormal weather with longer term averages.
 - We considered the time period 2005-2014 in our analysis.
 - £ values of losses are calculated using the latest quarterly national accounts data.

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