Scottish Fiscal Commission

# Forecasting the long-run potential of the Scottish economy

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## Contents

# Section 1: Introduction

1.1 The Scottish Fiscal Commission is committed to being open and transparent in our approach to forecasting. We are publishing a series of technical papers to enable further understanding of the methodology behind our main forecasts. One area of particular interest is how we forecast the economy over the long-run, and in particular our view on productivity.

1.2 This paper focuses on our methods for forecasting the long-run underlying trends in the Scottish economy, putting to one side shorter-term volatility or cyclicality. We forecast the long-run total potential capacity of the Scottish economy, considering broad changes in supply side conditions. This helps to shape our forecasts over the full six year period for which we create forecasts, with other models forecasting the fluctuations in the demand side of the economy over the short to medium term.

1.3 We set out our first economic forecast in our publication in December 2017, Scotland's Economic and Fiscal Forecasts (SEFF December 2017).[1] This paper explains the Commission's methodology for modelling and projecting potential output and the output gap in Scotland in further detail. Illustrative projections of potential output and its components are provided using the same methodology as in December but based on the latest available data, which will include some historic revisions.

1.4 Our forecast in December was based on the approach set out in this paper to forecasting the economy. The Commission will continue to consider all available data, evidence and information in producing its future forecast publications and may continue to make changes to both its methodology and its key judgements. We will provide updates on changes to methodology and judgements over time where appropriate.

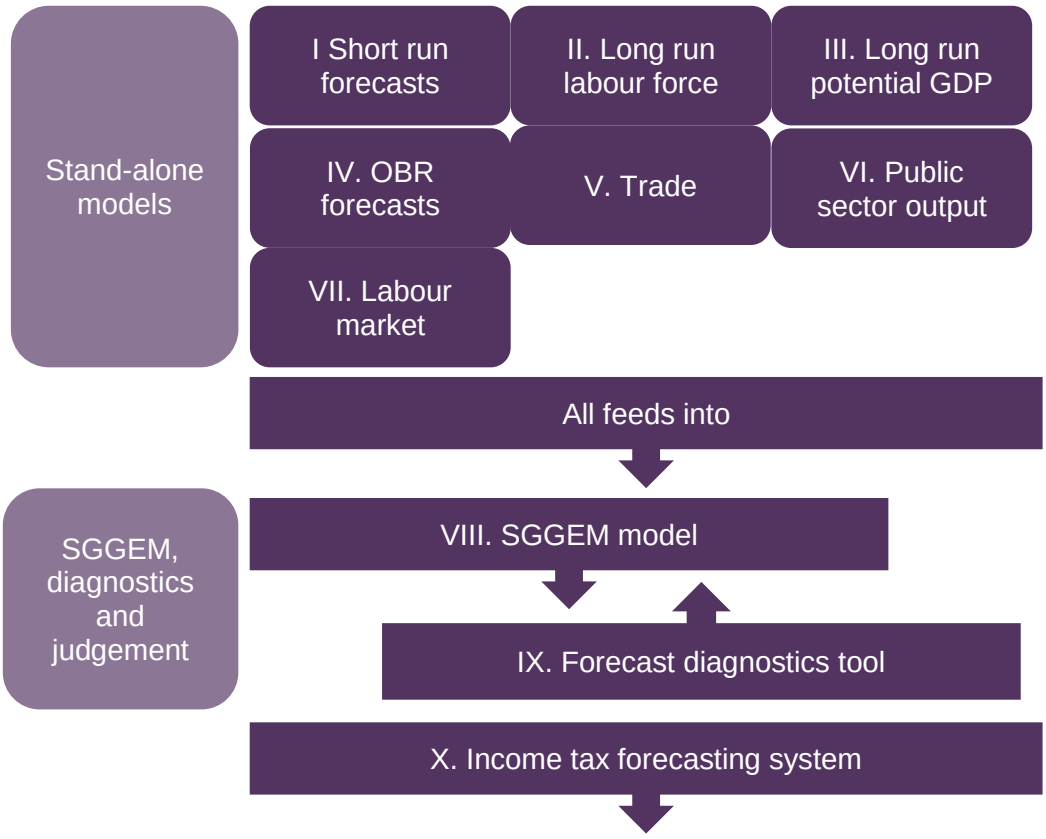
[1] SFC (2017) Scotland's Economic and Fiscal Forecasts (link)

# Section 2: General approach to forecasting the economy

2.1 In September 2017 the Commission published a paper explaining at a high level our approach to economic forecasting.[2] We use a range of different models for forecasting the economy. The models can be broadly grouped into short, medium and long run forecasting models.

2.2 The main components of our current forecasting process are shown in Figure 2.1.

**Figure 2.1: Schematic representation of economic forecasting process**




Source: Scottish Fiscal Commission

2.3 The current steps taken by the Commission to creating an economic forecast are:

I. **Short-run forecasts:** Official economic statistics by their nature are only available with a lag. Timely surveys of the Scottish economy can

[2] SFC (2017) Current Approach to Forecasting (link)

be analysed alongside other alternative sources of data to build up a picture of what is happening today and the likely pathway in the near future. Statistical models are used to create short-run forecasts for up to two quarters ahead. For each key variable, a number of ARIMA models are created, each with a single exogenous predictor variable. These are then averaged together using their relative predictive power, based on historic fit, to create short-run forecasts of selected key variables.

II. **Long-run labour force:** The potential labour force consists of people either in employment or actively searching for employment. The starting point for the long-run forecast of the labour force is the ONS/NRS population projections with detailed age and gender demographics. Forecasts for labour force participation rates are then applied by age and gender, to create total trend labour force levels. As well as feeding into the rest of the economic forecasts, this projection of the labour force is used in the income tax forecasting system.

III. **Long-run potential output:** Over our forecast horizon of five years, forecasts of GDP are anchored to our forecasts of potential output – the maximum capacity the economy can sustain to produce goods and services. This depends primarily on growth in productivity: the amount of goods and services that can be produced for a given amount of labour input. The forecast of potential output is produced by combining forecasts of the size of the labour force with forecasts of productivity and applying assumptions about trends in unemployment and average hours worked.

IV. **OBR forecasts:** The UK economy affects Scotland in two main ways: firstly, through a number of economic variables that Scotland shares with the UK as a whole, such as interest rates and exchange rates; and secondly, through trade as Scotland's largest trade partner. The starting point for these elements of the forecast is to consider the latest available OBR forecasts for the UK.

V. **Trade model:** Trade is challenging to forecast. Trade between Scotland and the rest of the UK is modelled based on growth in demand in both economies. Trade between Scotland and the rest of the world is then based on the OBR's UK trade forecasts, with some adjustment for Scottish circumstances.

VI. **Public sector output:** Government spending is a significant component of GDP. Public sector output is forecast by considering the available information on spending plans of both the Scottish and UK Governments in Scotland.

VII. **Labour market adjustments:** Combining the short-run forecasts and the long-run trend forecasts of the labour force, we create a medium term adjustment pathway for employment and unemployment. A long-run trend rate of unemployment is targeted in the forecast, with additional judgement applied based on available intelligence on the state of the Scottish labour market

VIII. **SGGEM model:** The SGGEM model sits at the core of the economic forecasting process. It is an extension to NIESR's long-established NiGEM macroeconometric model.[3] All of the above projections are fed into SGGEM which is then used to create forecasts for remaining variables and time periods.

IX. **Forecast diagnostics tool:** Forecasts from SGGEM are then analysed in a separate diagnostics tool. This is to check the characteristics of the forecast and allow the Commission to hone and sense-check key judgements. The steps above can be repeated to tweak the forecast and apply further judgement as necessary. These diagnostic checks include the ratio productivity to wages, the savings ratio and net trade as a share of GDP.

X. **Income tax forecasting system:** Once the economic forecasts are complete, the forecasts of wages, employment and hours worked are fed into the income tax forecasting system.

2.4 In this paper, we set out in more detail our approach to forecasting the economy over the longer-term mentioned in steps II and III. In the context of our forecasts, the longer term is considered to be the next six years. This approach primarily considers the supply side of the economy, with other models forecasting the pathway of the demand side of the economy over the short to medium term. Potential output – or the trend amount of goods and services the economy can sustainably produce – is estimated and projected. This requires modelling of population, the labour market and labour productivity to generate potential output.

2.5 Models provide insight and guidance, but judgement plays an important role. Judgment is required in both how the models are operated, and how the results from different models are used and combined. Ultimately, the forecast will be driven by the judgements of the Commission, rather than depending mechanically on the output of any one model.

[3] NIESR – The National Institute of Economic and Social Research, a charity and Britain's longest established independent research institute (link). For further information on the NiGEM model see (link)

# Section 3: What is potential output?

## Overview

3.1 Potential output is the estimated amount of goods and services the economy can sustainably produce without inducing excess price inflation in the economy. In the short term actual output can deviate from potential output, but over the longer term the economy is assumed to be subject to the supply constraint of potential output.

3.2 Estimation of potential output is crucial for forecasting the economy for two reasons:

- The capacity of an economy to generate sustainable growth determines structural growth
- The output gap is the relationship between potential and actual output and this implicitly determines the cyclical position of the economy

3.3 One of the main challenges in projecting potential output is that the supply capacity of an economy is not observable. Instead, we capture the underlying trends by decomposing output by supply factors, as well as incorporating the best available intelligence for estimating potential output. Judgement is inevitably needed to incorporate the available qualitative and quantitative intelligence into our potential output projections.

3.4 This part of the forecasting process is therefore heavily influenced by the judgement of the Commission. We use a variety of models and techniques to identify the underlying trends in the supply side of the economy, but our forecast of potential output is ultimately a judgement about how these trends will evolve in the future.

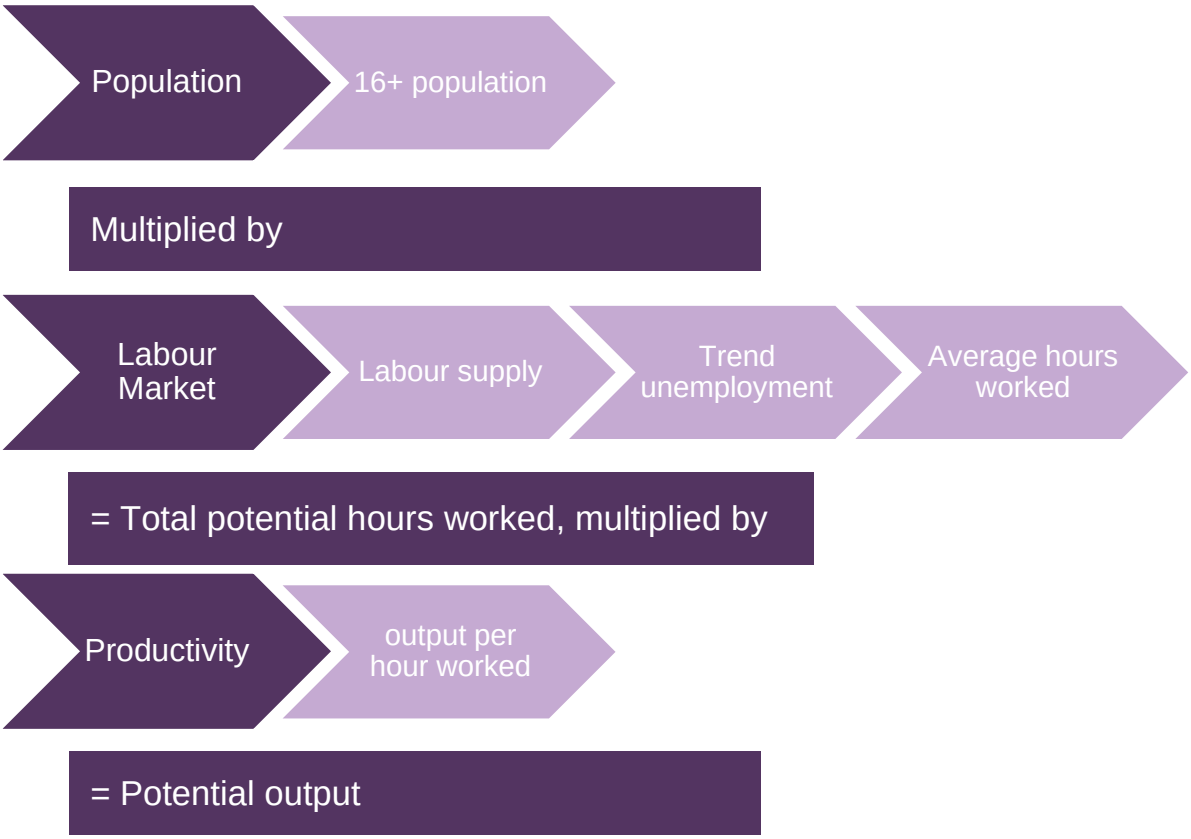
## Production function methodology

3.5 We build up our view of potential output by estimating historic trends and projecting its individual components: population; the labour market and; productivity. By forecasting each of these individually, a picture of total potential output in the future can be constructed. A schematic representation of this is provided in Figure 3.1 This methodology is widely used for forecasting potential output, notably by the OBR, the European Commission and the OECD. [4] [5] [6]

[4] OBR, 2014, Working paper No.5: Output gap measurement: judgement and uncertainty (link)

[5] D'Auria, F., Denis, C., Havik, K., McMorrow, K., Planas, C., Raciborski, R., Roger, W., and Rossi, A., 2014. "The production function methodology for calculating potential growth rates and output gaps", European Economy- Economic Paper No.420, European Commission, (link)

**Figure 3.1: Schematic representation of forecast of potential output**




Source: Scottish Fiscal Commission

3.6 The Commission does not consider capital – for example plant and machinery – or other factors of production as part of this process, leaving labour input as the only factor of production. One of the reasons is because capital stock and business investment data for Scotland are limited and generally heavily modelled. Potential output is determined by the combination of total labour input and labour productivity. The implication is that our estimates of labour productivity reflect changes not only in total factor productivity, but also changes in capital stock on production.

3.7 The Commission's methodology for projecting potential output consists of a bottom-up approach for projecting and combining labour input and productivity. In general, the process can be described as follows:

I. Decompose each factor to incorporate the underlying trends to our projections. For factors associated with labour markets, we

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[6] Beffy, P.O., Ollivaud, P., Richardson, P. and Sedillot, F., 2006. New OECD methods for supply-side and medium-term assessments: a capital services approach. OECD Economics Department Working Paper No.482, (link)

decompose by age ranges and gender. For output variables, we decompose by production industry.

II. Remove any cyclicality, volatility and noise from our variables through trending and filtering techniques. This enables us to capture the long run trends of the historic data and filter out shorter term noise and volatility. This process also makes some judgements about identify the underlying trends.

III. Project the path for each smoothed component. This is based on observing recent growth in the series, judgement and any external information, such as population projections. Largely this is an empirically driven approach.

IV. Combine the factors to obtain potential output.

3.8 This bottom-up approach enables us to identify the contribution of different factors to potential output growth, as well as assessing the sensitivity of the forecast to variations in these factors.

3.9 One limitation to this approach is that it is a combination of stand-alone models, so this modelling framework does not automatically incorporate feedback effects between factors. The Commission applies additional judgement to control for this.

# Section 4: Forecasting the components of potential output

4.1 The following section illustrates our approach, providing details about the projection of the individual factors: population, participation, unemployment, average hours worked, which make up labour input, and labour productivity. The projections published in our Scottish Economic and Fiscal Forecasts (December 2017) and some of the detail of the calculations behind them are provided in a workbook published alongside this paper.[7]

## Population

4.2 Population growth is a fundamental determinant of growth in the economy. All else being equal, the larger the population, the larger the economy. As well as the total size of the population, it is also important to understand how the age and gender structure of the population may change, as labour market trends vary by groups.

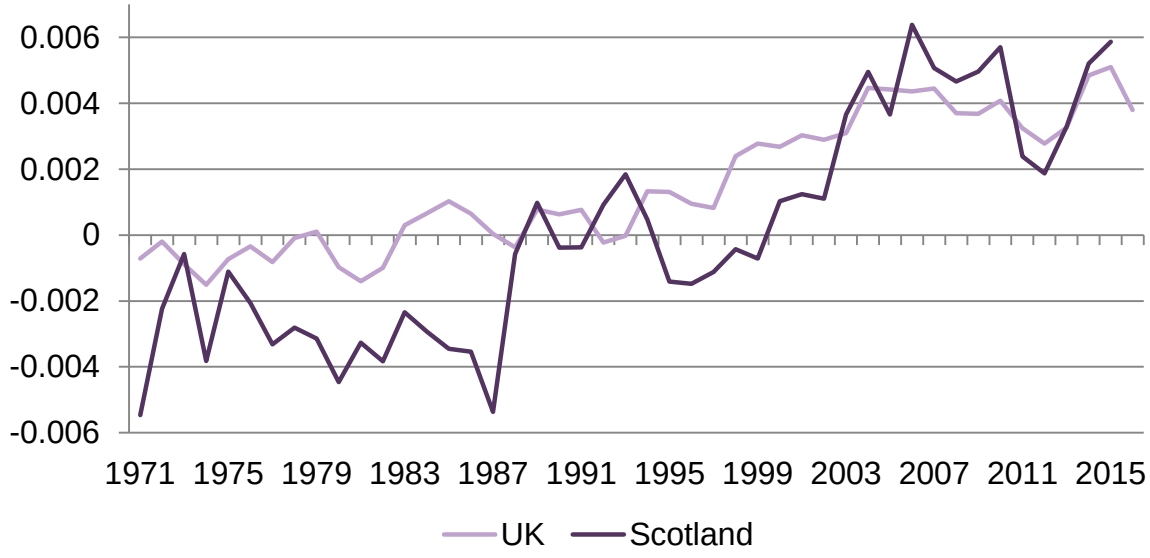
*Historic trends*

4.3 We start by considering detailed population forecasts broken down by age and gender. For this we use the National Records of Scotland (NRS) mid-year population data and 2016 based ONS/NRS population projections.

4.4 Historically, Scotland has had slower population growth than the UK as a whole. This has been due in part to lower levels of net migration, with net outflows of population from Scotland for much of the 1970s, 1980s and 1990s. Figure 4.1 shows net migration per capita in Scotland and the UK.

[7] Scottish Fiscal Commission (2018) Potential output calculation detailed workbook (link)

**Figure 4.1: Net migration per capita, Scotland and UK**




Source: Scottish Fiscal Commission

4.5 Since the early 2000s, Scotland has had higher levels of net inward migration than observed historically. The level of this has been comparable in relative terms to levels of net migration into the UK.

4.6 Scotland also has an ageing population, with the number of individuals aged over 65 increasing relative to the population as a whole. Growth in the 16 to 64 year old population, those with the highest labour market participation, has slowed significantly in recent years.

*Our judgement*

4.7 The ONS and NRS produce a range of variants of their population forecasts based on varying assumptions around fertility, mortality and migration. On fertility and mortality, the Commission uses the principal projections.

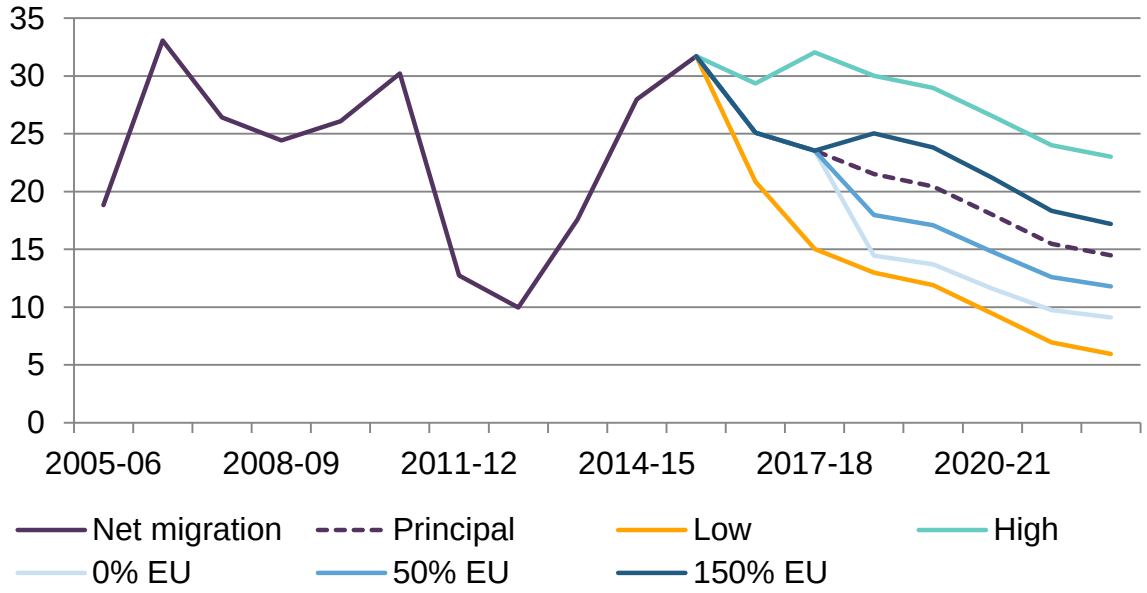
4.8 Migration is a key uncertainty, particularly with the prospect of the changing relationship between the UK and the EU. As Figure 4.1 shows, Scotland has moved from having negative net migration for most of the period 1971 to 1999 to a period of strong positive net migration. There are two aspects to the Commission's judgement on migration:

I. Aside from the impact of UK-EU exit, would more recent levels of positive net migration have been sustained or would Scotland have returned towards longer-term historic trends?

II. How will UK-EU exit affect future Scottish migration?

4.9 Figure 4.2 shows the range of available migration variants from the ONS population projections.

**Figure 4.2: Scottish net migration historic data and projections with migration variants, thousands**




Source: NRS (2017) total migration to or from Scotland (link), ONS/NRS (2017) 2016-based population projections (link)

4.10 All of these variants assume that current high levels of net migration will not be sustained and that net migration will gradually reduce.

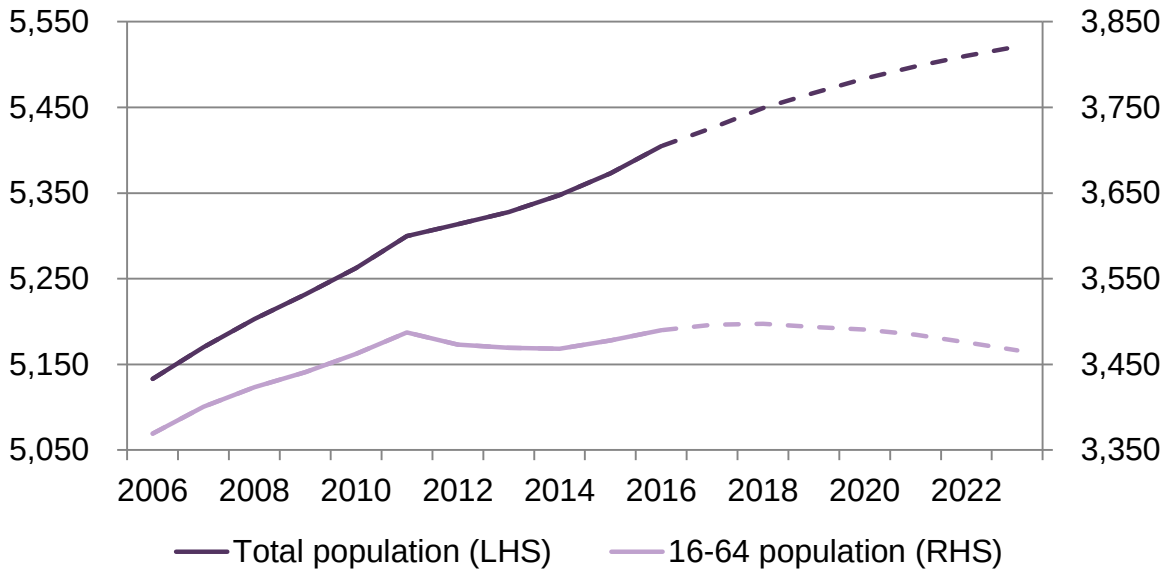
4.11 For our December 2017 forecasts, the Commission judged the 50 per cent EU migration scenario to best describe the context in Scotland because of the potential impacts of the changing UK-EU relationship on net migration.

4.12 The Commission will closely monitor forthcoming migration data releases and update our assumption if necessary.

*Forecast*

4.13 As shown in Figure 4.3, the Commission's population forecasts show modest population growth amongst those aged 16 plus, albeit slower than the growth forecast by the OBR for the UK. The 16 to 64 year old population is expected to start to shrink in Scotland within the next five years.

**Figure 4.3: Scottish total population and 16 to 64 year old population, thousands**




Source: NRS (2017) mid-year population estimates (link), ONS/NRS (2017) 2016-based population projections (link)

## Participation

4.14 Labour force measures engagement in the labour market: it is the total number of individuals who are either in work or are actively looking for work. Together with population and demographics, participation determines the size of the labour supply.

*Historic trends*

4.15 The Commission uses participation data from the Labour Force Survey (LFS) as the basis for our forecasts, which are decomposed between males and females aged over 16 years.

4.16 Historically labour market participation rates have varied between different age groups and genders. For example, participation rates amongst those aged 16 to 24 have declined steadily since 2004, in line with a gradual increase in participation in further education. The 16 to 24 age group has also seen strong convergence of participation rates between males and females, with men and women having broadly similar labour market participation at this age.

4.17 Another strong feature of recent trends in the labour market has been the increasing participation of those aged 55 to 64 and over 65s. There are a number of contributing factors including longer healthy working lives and slow growth in real incomes since 2008 leading to later retirement.

*Our judgement*

4.18 Our forecasts are primarily based on assuming that the trends observed in each age group and gender continue in the near future. This empirical approach would not be appropriate for a forecast horizon longer than five years. For example, it is unlikely that participation amongst those aged 16 to 24 will continue to decline at the same rates observed since 2004, and that this trend is likely to flatten out over a longer time horizon. We judge this approach to be appropriate for the time horizons we are forecasting.

*Our forecasts*

4.19 Our projections for labour market participation rates, broken down by age and gender, are shown in Figures 4.4 to 4.9.

**Figure 4.4: Participation of 16-24,%**

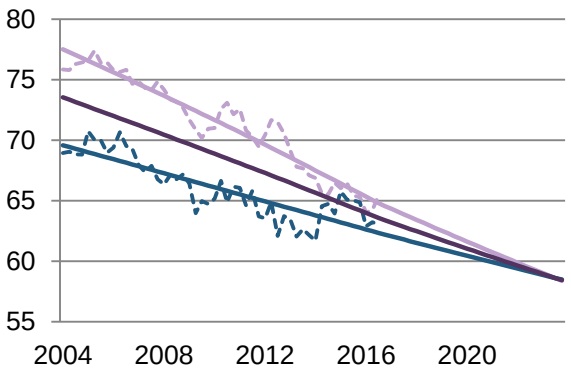



**Figure 4.5: Participation of 25-34,%**


**Figure 4.6: Participation of 35-44,%**

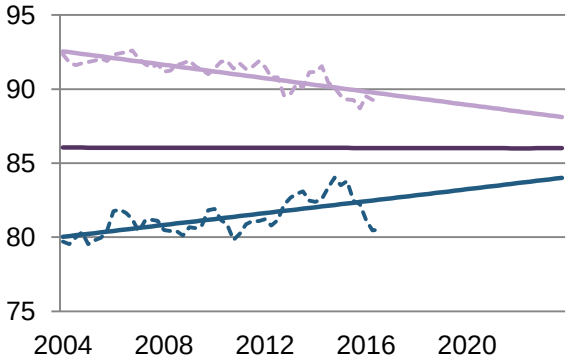



**Figure 4.7: Participation of 45-54,%**

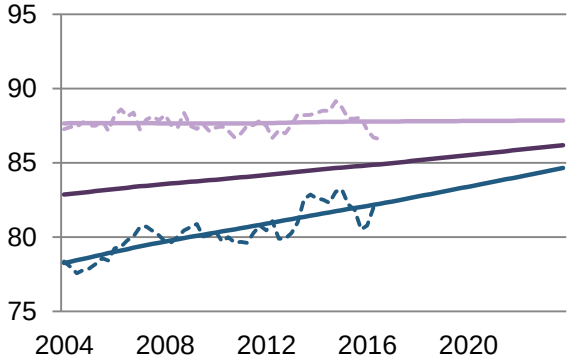


**Figure 4.8: Participation of 55-64,%**

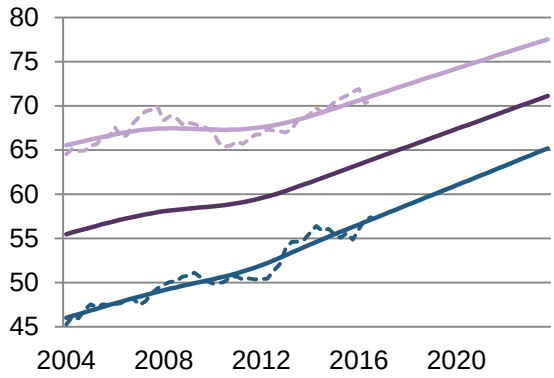
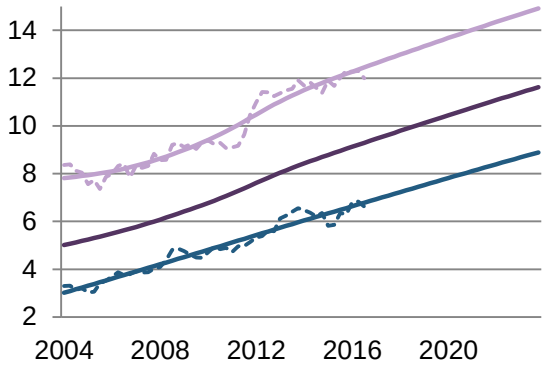
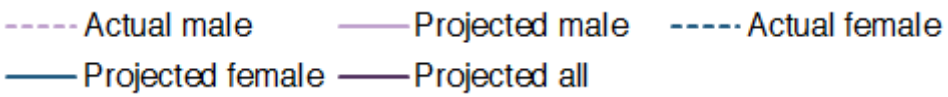



**Figure 4.9: Participation of 65+,%**



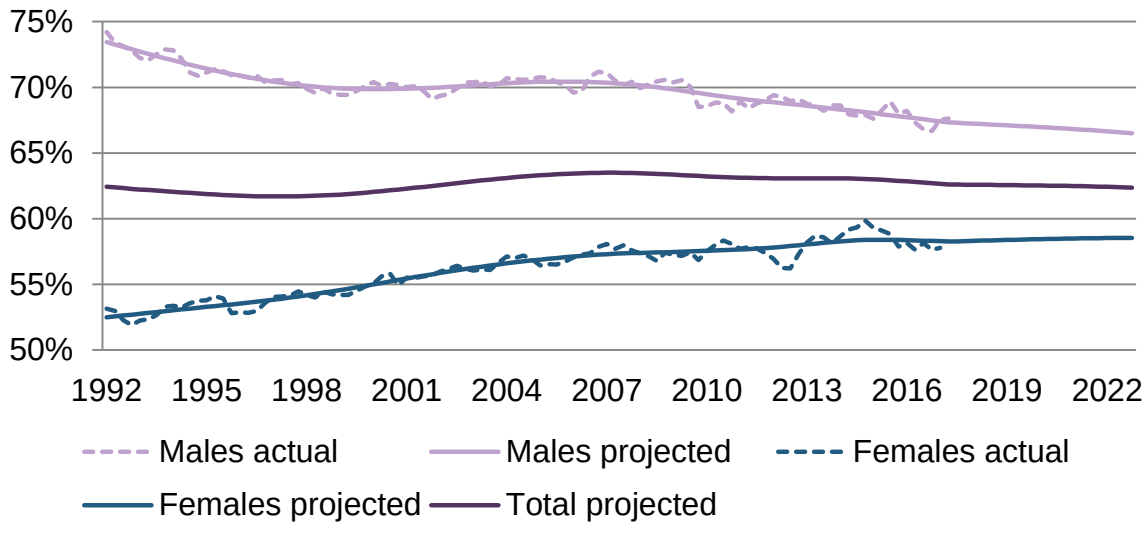




Source: Scottish Fiscal Commission

4.20 The projections in Figures 4.4 to 4.9 show that participation rates are expected to continue to decline for those aged 16 to 24, be flat for individuals aged 25 to 34 and 35 to 44, and to increase for all individuals over the age of 45.

4.21 The Commission combines the decomposed participation projections with their respective population shares and applies this projection to our historic participation estimates from the Labour Force Survey (LFS). As shown in Figure 4.10, this displays a mild trend for gender participation rate convergence, as well as a slightly decreasing participation rate of all individuals aged 16 and over.

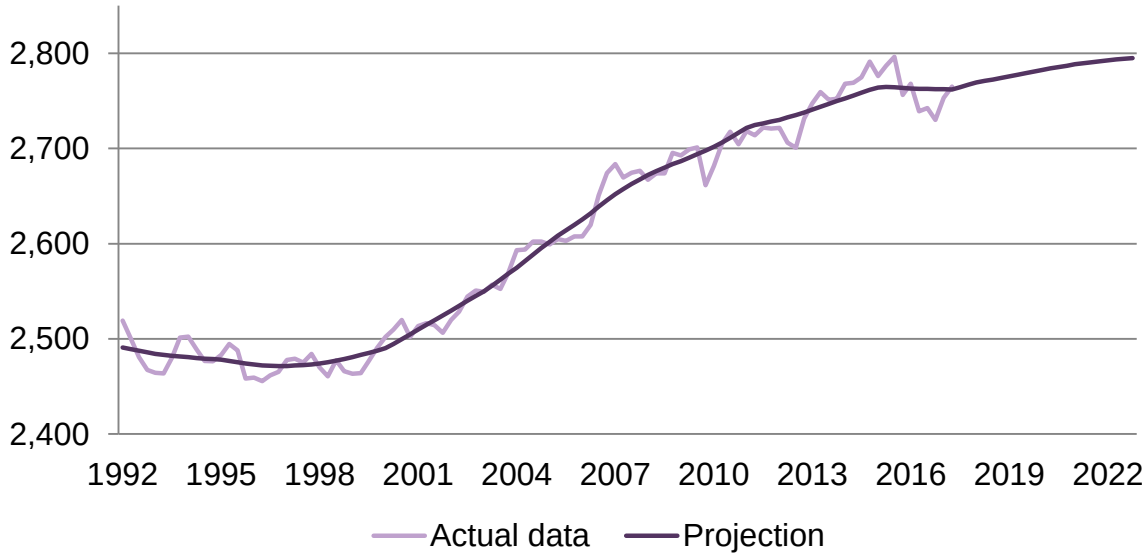
**Figure 4.10: Labour market participation rates for the population aged 16 and over, %**




Source: Scottish Fiscal Commission

4.22 Figure 4.11 shows that despite a forecast of a slightly decreasing participation rate, the participation level is expected to continue to increase as the Scottish population grows, albeit at a slower rate than in the recent past.

**Fig 4.11: 16+ participation level, thousands**




Source: ONS (2017) Regional labour market statistics in the UK (link), Scottish Fiscal Commission

## Unemployment

4.23 Unemployment describes those individuals who are not currently in employment but are actively looking for and available to start work. They are considered part of the available labour supply.

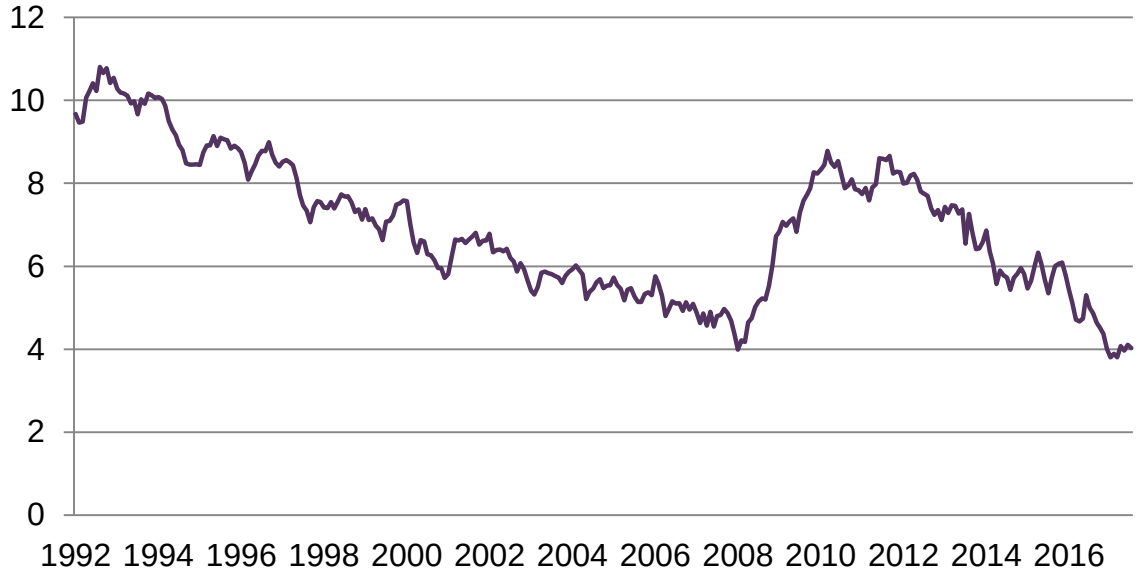
4.24 A small amount of short-term unemployment will mean firms have a pool of available labour from which to hire. If unemployment becomes too low, firms will struggle to recruit and this can place upwards pressure on wages, leading to inflation. When the economy is operating at its potential, we would expect unemployment to be low and stable, but not so low that excess wage pressures are generated. This point is known as the Non-Accelerating Inflation Rate of Unemployment (NAIRU) – the trend rate of unemployment consistent with low inflation.

4.25 To forecast employment over the longer-term, the Commission produces a forecast of the NAIRU.

*Historic trends*

4.26 The Commission bases its unemployment forecasts on data from the LFS. The LFS unemployment rate data are shown in Figure 4.12.

**Figure 4.12: Scottish 16+ unemployment rate, %**




Source: ONS (2017) Regional labour market statistics in the UK (link)

4.27 Since the early 1990s, unemployment has gone through two main phases. In the period leading up to the financial crisis around 2008, unemployment rates decreased significantly and this seems to imply a systematic decline in the NAIRU over this period of time. The financial crisis caused the unemployment rate to increase dramatically to a peak of 9 per cent, following which unemployment rates have decreased to the currently observed historic lows of around 4.0 per cent.

*Our judgement*

4.28 The Commission does not rely on the output of any specific model for determining the NAIRU. Instead, we incorporate the available evidence and intelligence to form a judgement about trend unemployment both during the historic period and the forecast.

4.29 The Commission judges that the trend unemployment rate in Scotland declined steadily from 1992 to 2008. Had the financial crisis not occurred, we would have seen this decline start to level off. Whilst the financial crisis caused a strong cyclical increase in the unemployment rate, it does not appear to have had a long-run impact on the NAIRU, with unemployment rates rapidly declining to levels of 4.0 to 4.5 per cent in recent years.

4.30 In its December 2017 forecast, the Commission judged the NAIRU to be 4.5 per cent. This is lower than the unemployment rate observed in much of the period preceding the financial crisis. We see several reasons for a reduced NAIRU:

- *Low pressures on wages:* Wage pressures appear generally weak despite low unemployment. This may be due to: business uncertainty following the financial crisis and with the changing relationship between the UK and the EU; slow wage growth in the public sector; and more strongly anchored inflation expectations than in the past.
- *Demographic composition of the labour market:* The share of the labour force aged between 16 and 24 years old is decreasing over time. Because this age range has the highest unemployment rates, a decline in its share of the labour force contributes toward a reduced rate of unemployment. Similarly, women have lower rates of unemployment, and the increasing share of women in the labour market has increased over time. This has arithmetically reduced average unemployment rates.
- Individuals may be more willing to relocate for work than in the past because of improved connectivity and communication
- New technology allows for more flexible and remote working
- New technology allows for quicker and more efficient job market matching
- Increases in self-employment and “gig-economy” work

*Our forecasts*

4.31 The Commission’s judgement on NAIRU is that it will remain at 4.5 per cent over the forecast period.

## Average hours worked

4.32 We use total hours worked as our measure of total labour input. This is a multiple of the number of people in employment and the number of hours each person works on average. Our forecasts of population, participation and unemployment allow us to produce a forecast of trend employment. This section provides details on how we forecast average hours worked and how this leads to our forecast of total hours worked.

*Historic data*

4.33 The Commission uses Annual Population Survey (APS) as its source of data on hours worked. In order to project the path for average hours per worker, average hours are decomposed by different working patterns for males and females.

4.34 The historic data show:

- In both Scotland and the UK as a whole, average hours worked has been steadily declining for some time. In the UK, average hours

worked has declined from around 36 hours a week in the 1970s, to around 32 hours a week today, and Scotland has followed similar trends in the shorter series of data available. However, this process of gradual decline appears to be slowing and levelling off.

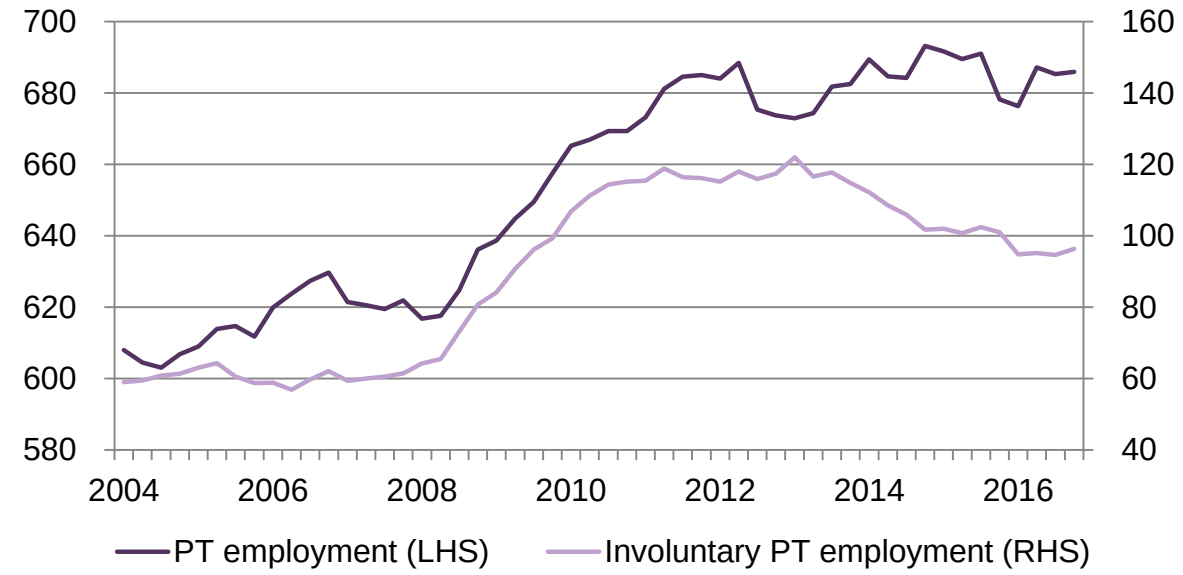
- On average, men work more hours than women. This is in part the result of women being more likely to work part-time, but even within full-time work, men work more hours on average. This gap has been gradually closing over time, with women starting to increase their average hours worked in recent years, and a slight but persistent decrease in average hours worked amongst men.
- The financial crisis led to a sharp increase in the proportion of both men and women in part-time work. This was due to low demand in the economy and a lack of availability of full-time jobs. For women, following this shock, the share in part-time work has unwound to previous levels, but there appears to be a more permanent shift in the proportion of men working part-time. It appears that the shock of the financial crisis had a permanent effect on part-time work amongst men.

*Judgement*

4.35 The Commission takes a largely empirical approach to forecasting average hours worked. In most cases, we assume that the recent trends we have observed by gender and working pattern will continue.

4.36 The financial crisis appears to have generated a small but permanent shift in men's working patterns. This view is supported by the data on involuntary part-time working. Figure 4.13 illustrates that while the number of part time workers has stayed high since the beginning of the crisis, the fraction of those that would like to switch to full time has significantly decreased since 2013, indicating that, over time, more individuals have decided that they would like to work part-time.

**Figure 4.13: Level of part time employment and involuntary part time employment, thousands**




Source: ONS (2017) Regional labour market statistics in the UK (link)

*Forecasts*

4.37 Figures 4.14 to 4.19 show our estimated historic trends and forecasts of average hours worked by gender and working pattern.

**Figure 4.14: FT hours worked**

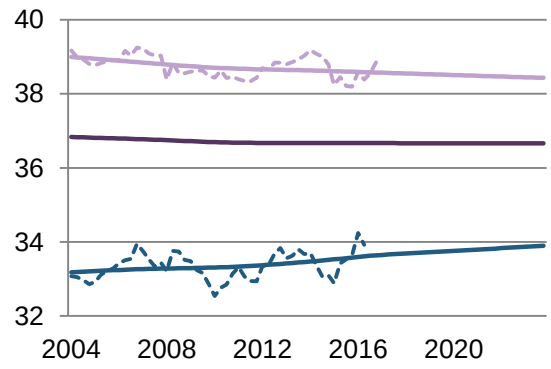



**Figure 4.15: PT hours worked**

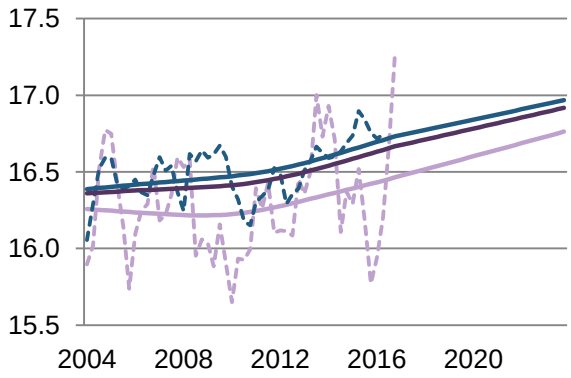


**Figure 4.16: Share of males PT, %**

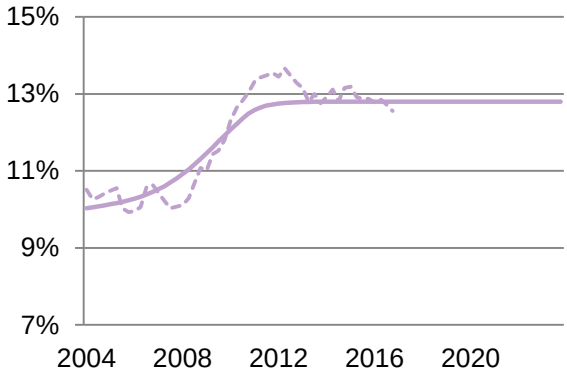



**Figure 4.17: Share of females PT, %**

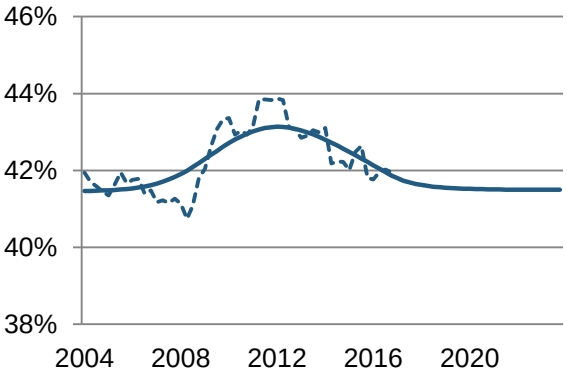



**Figure 4.18: Second jobs hours worked**

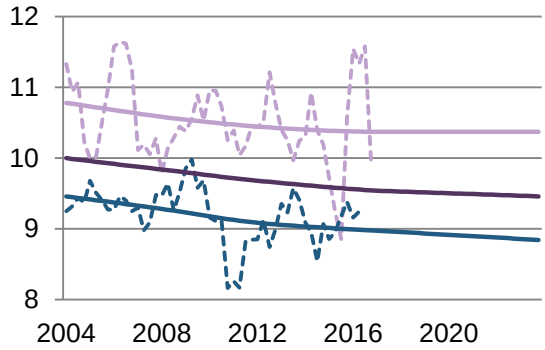
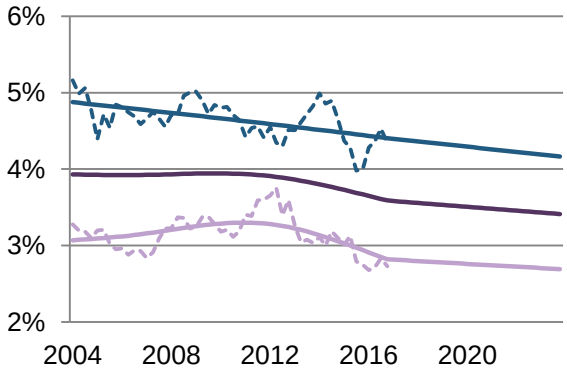
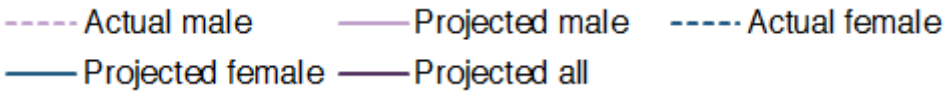



**Figure 4.19: Fraction of second jobs, %**




Source: Scottish Fiscal Commission

4.38 Combining the forecasts for average hours worked and their respective shares of employed people, we obtain the projection path for our average hours worked for males and females. These are shown in figures 4.20 to 4.21. The Commission projects males average hours per worker to slightly decrease, while females average hours worked are projected to increase over the forecast horizon. This results in a broadly constant profile for average hours worked in Scotland over the forecast horizon.

**Figure 4.20: Average hours worked by males**

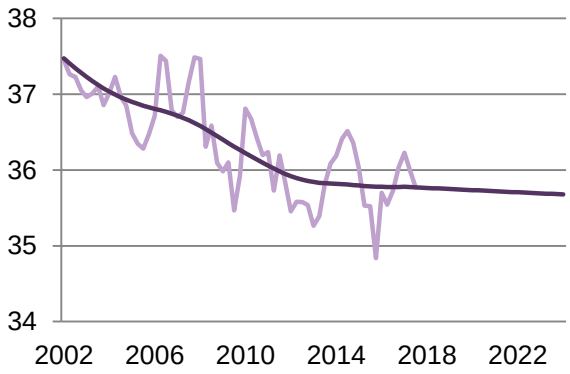
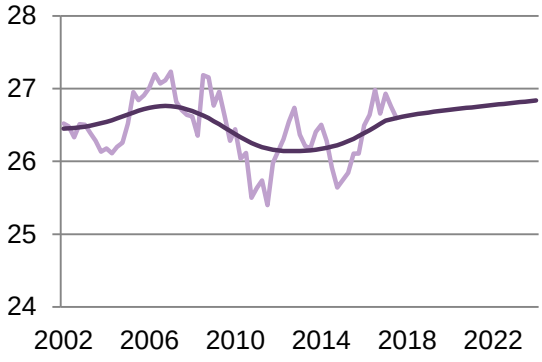
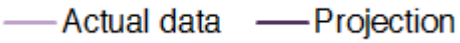



**Figure 4.21: Average hours worked by females**




Source: Scottish Fiscal Commission

4.39 The Commission uses data from APS for hours worked, but data from the LFS for employment. These two different surveys of the labour market introduce a slight inconsistency. Whilst we utilise information on disaggregated average hours worked from the APS, we are ultimately more interested in total hours worked.

4.40 To get a value for total hours worked that is consistent with our underlying APS analysis of average hours worked, but also consistent with our LFS employment values, we apply the following process:

1. Generate our underlying forecasts of average hours worked from APS as described above
2. Take data on total hours worked from the APS and divide this by LFS employment. This creates a slightly different series for average hours worked than the APS estimate.
3. Grow this average hours worked estimate in line with our APS based projection of average hours worked derived in step 1.
4. Multiply back up by our LFS employment forecast to estimate total hours worked.

4.41 Figures 4.22 to 4.23 show our forecasts of trend total hours worked.

**Figure 4.22: Total hours worked by males, millions**

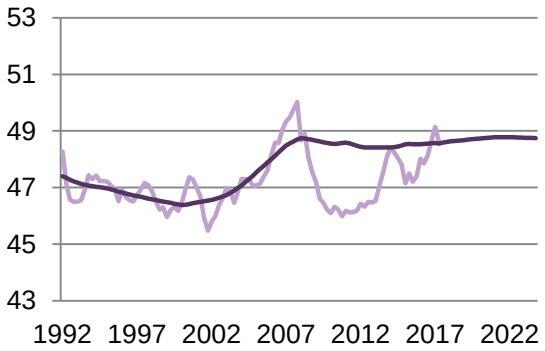
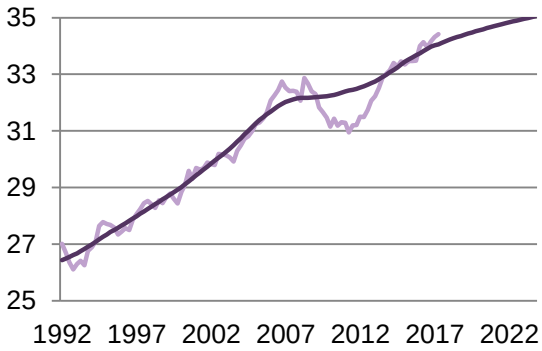
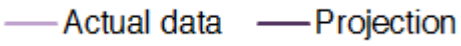



**Figure 4.23: Total hours worked by females, millions**

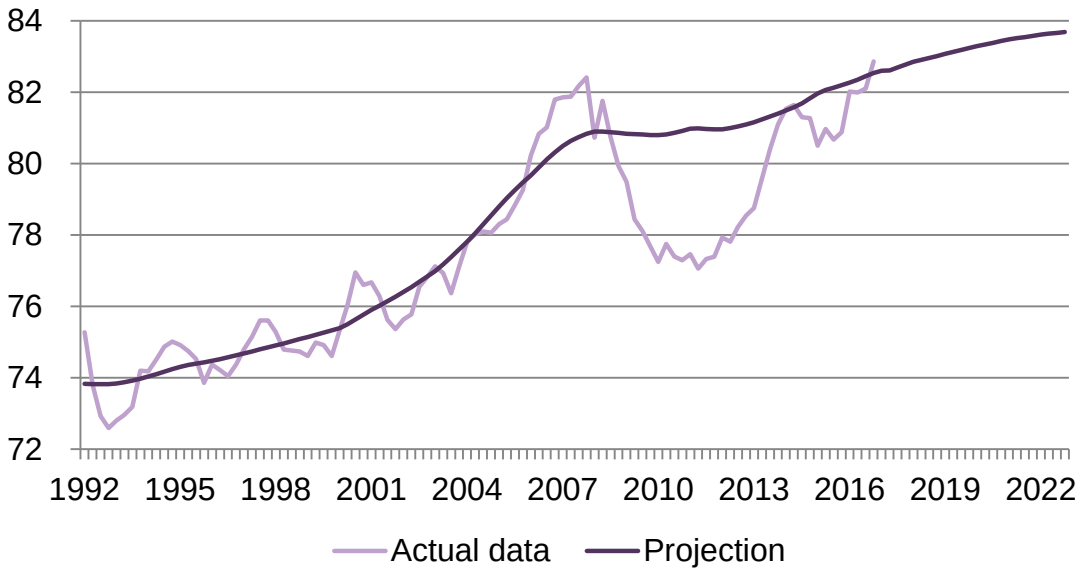



Source: Scottish Fiscal Commission

4.42 The Commission projects a relatively flat profile for total hours worked by males, while total hours worked by females is projected to increase driven by both greater participation and greater average hours worked. Figure 4.24 shows our forecast of total trend hours worked in Scotland.

**Figure 4.24: Total hours worked projection in Scotland, millions**




Source: Scottish Fiscal Commission

## Labour productivity

4.43 Labour productivity is defined as the amount of output produced for each hour worked. This is the main driver of economic growth. The Commission obtains the estimates for labour productivity by dividing GDP by its estimate of the total number of hours worked.

4.44 The projections for productivity are heavily influenced by judgment.

4.45 Productivity growth has been slowing in a number of developed economies over the last decade. The reasons for this are a matter of debate, with no emerging consensus. Whilst the Commission does not seek to explain the fundamental reasons why productivity growth has slowed, we do have to make a judgement on whether this slow growth is a temporary phenomenon driven by one-off factors or a new normal.

*Historic data*

4.46 The Commission uses productivity estimates that come from dividing real GDP indices by APS total hours worked. Productivity growth in Scotland appears to have been slowing since around 2004. This is part of a global phenomenon in advanced economies, with the productivity puzzle not yet well understood.

4.47 It is useful to look at productivity by industry. The construction industry in Scotland recently went through a period of boom that has supported Scottish GDP growth. However, this increase in construction sector output was accompanied by an equivalent increase in employment and does not appear to be a sustained effect. This has created a somewhat artificial increase in productivity in Scotland. If we expect construction productivity to return to trend in the following quarters, we need to control for this effect in generating appropriate productivity projections.

4.48 Figures 4.25 to 4.26 show the Commission's decomposition of productivity for the construction and the non-construction industries. Further detail of this analysis is provided in Annex 1.

**Figure 4.25: Productivity excluding the construction industry, index**

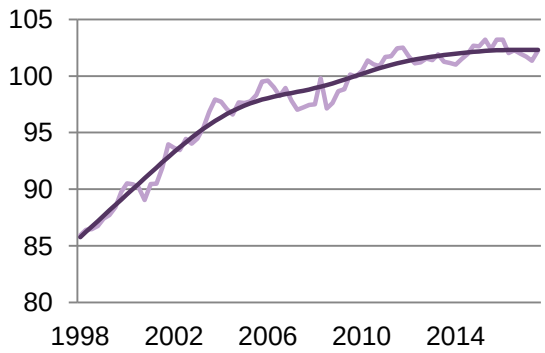
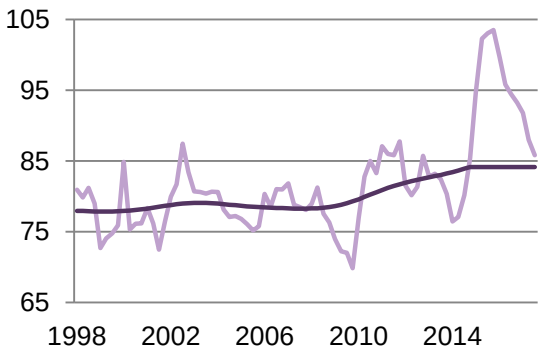
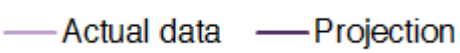



**Figure 4.26: Productivity in the construction industry, index**



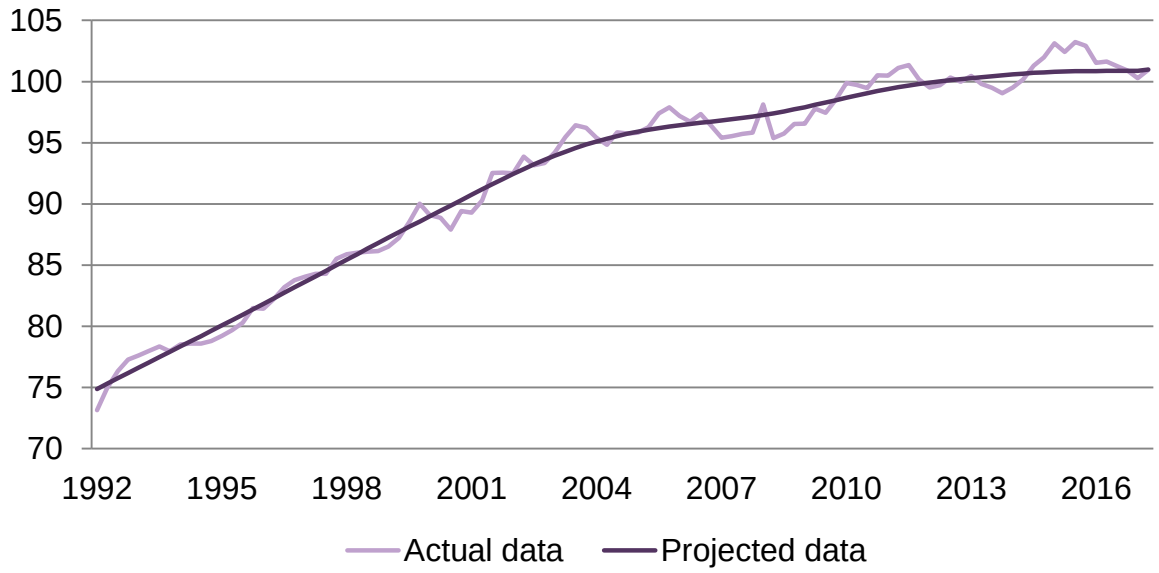




Source: Scottish Fiscal Commission

4.49 In the Commission's view, stripping out the effect of the construction industry, productivity growth in Scotland has been weaker than suggested by the headline figures.

4.50 The Commission's estimates of historic trend productivity are shown in Figure 4.27. Prior to 2008, the average annual growth in productivity was 1.6 per cent, since 2008 it has averaged 0.5 per cent.

**Figure 4.27: Actual and trend productivity, Index 2014 = 100**




Source: Scottish Fiscal Commission

*Judgement*

4.51 There are a number of factors considered to explain the slowdown in productivity observed since the onset of the financial crisis. Some evidence supports the argument for a temporary slowdown in productivity growth whilst other evidence supports the argument for a more permanent slowdown.

4.52 Factors lending support to the view of a temporary slowdown in productivity growth include:

I. *Tight credit conditions:* Following the financial crisis credit conditions were tightened. Banks were less willing to lend to smaller firms and, despite low central bank interest rates, effective interest rates increased. This restricted the ability of firms to grow and invest in new capital, R&D, training etc. This has had a knock on effect on productivity growth. However, this effect will unwind as credit conditions normalise.

II. *Low capital investment:* Because of tight credit conditions, low consumer demand, low business confidence and a weak outlook for profitability, firms scaled back on capital investment. A falling level of the quantity and quality of capital would limit growth in labour productivity.

III. *Particularly low investment in R&D*: Investment in intangibles – a driver of long term productivity growth - was further reduced and postponed in favour of investment in tangibles. Tangibles investment is most profitable for short term needs and firm survival. R&D investment may also have suffered from tighter credit market conditions because investment in intangibles does not have collateral value.

IV. *Misallocation of resources:* One common narrative following the 2008 shock was around so-called “zombie firms” and “labour hoarding”. Both would be examples of a misallocation of resources. Firms that had otherwise failed but were being artificially propped up by banks would divert the supply of credit away from otherwise potentially successful firms. Similarly, firms that were performing poorly but expected profitability to return soon would hold onto the labour it currently had to avoid a loss of human capital that it would have to later rebuild. Again, if this restricted the supply of labour to potentially more profitable firms, this could have held back GDP and productivity growth.

V. *Labour market structure and low productivity jobs:* The initial shock to demand in the economy in 2008 led to an increase in unemployment. Labour market flexibility has allowed employment to return to high levels despite subsequent slow economic growth. However, this appears to be associated with individuals moving into low productivity and low-wage jobs, with some degree of skills underemployment. This structural issue in itself will hold back growth in the short term, before the labour market gradually readjusts to close the underemployment gap. Longer-term, a highly skilled employee working in a low skill job made lead to an erosion of skills over time, and reduce incentives for capital investment , which may both hold back productivity growth.

VI. *Sector specific issues:* Financial services made significant direct contributions to GDP growth in both Scotland and the UK prior to 2008. Subsequent weakness in this sector may explain some of the lack of GDP growth, and therefore productivity growth.

VII. *On-going lack of external and domestic demand:* Following 2008 consumer confidence has been weak and export demand from the UK and Scotland’s trade partners has also been weak. In addition,

lower public sector spending as a result of the austerity programme of the UK government will have directly reduced consumption and GDP.

4.53 Explanations I – V represent temporary supply-side issues. Explanations VI and VII are more demand side and would imply that a lack of demand has held back GDP growth, but that the output gap is larger than expected and trend productivity is some way above observed productivity.

4.54 On the other hand, viewing the observed slow growth in productivity being a more permanent feature of the economy would be explained by:

I. *Technological change and measuring GDP:* historical significant technological progress such as motors and cars, the advancement of computers, cheap air travel, mass globalised production resulted in the production of "normal" well understood goods and services that are easily measured. More recent technological innovation, such as digital innovation, is harder for GDP to capture, may not be captured in GDP at all, or may even replace previous activities that were counted in GDP (for example online travel booking replacing travel agents). Whilst there is some activity going on that provides utility to consumers, this is not captured in GDP.

II. *Slower technological growth:* Productivity will be driven by, amongst other things, growth in technology. Despite obvious technological developments of the last decade such as smart phones, tablets, digital services etc., the growth rate of technology is actually slowing. This may be due to the increasingly high costs of technological innovation.

III. *Some historic growth may have been higher due to one-off factors:* A slowdown in productivity growth may have been happening longer than currently understood but GDP was kept artificially high during the late 1990's and early 2000's thanks to rapid globalisation. Both on the supply side and demand side, rapid globalisation would have provided many new consumers for Scottish and UK goods and also provided cheap labour, keeping wages low. This may have allowed growth rates to be sustained at a higher rate than would otherwise have been the case. Now that globalisation may be going into reverse, these opportunities may be absent in the coming decade, with less support for the Scottish economy from trade.

4.55 Whilst we can do more research into both of these broad narratives, there is no fixed view within the community of economists. Ultimately our choice of narrative, and therefore pathway of GDP, will come down to judgement, and which narrative we find more compelling.

4.56 Beyond these global factors driving slower productivity growth, there are some Scottish specific factors that could be amplifying the “productivity puzzle” in Scotland.

I. *The slowdown has been happening for longer than widely believed:* Our analysis shows that the slowdown in productivity growth actually happened around 2004, rather than simply following the 2008 recession. Whilst the 2008 recession will have had an impact, there may be more fundamental changes occurring.

II. *The oil and gas industry:* The oil and gas industry contributed to Scottish growth, but after prices plummeted in 2015, greatly reducing demand for goods and services in the onshore supply chain. While Scottish productivity performed relatively better than UK productivity during the first years after the financial crisis (2008 to 2014), Scottish productivity performance has been relatively poor since 2015. Part of this could be explained by the Oil and Gas sector.

III. *Changing UK-EU relationship:* All else equal, trade and international competition are recognised to support growth in productivity. This could act as a drag for productivity in Scotland.

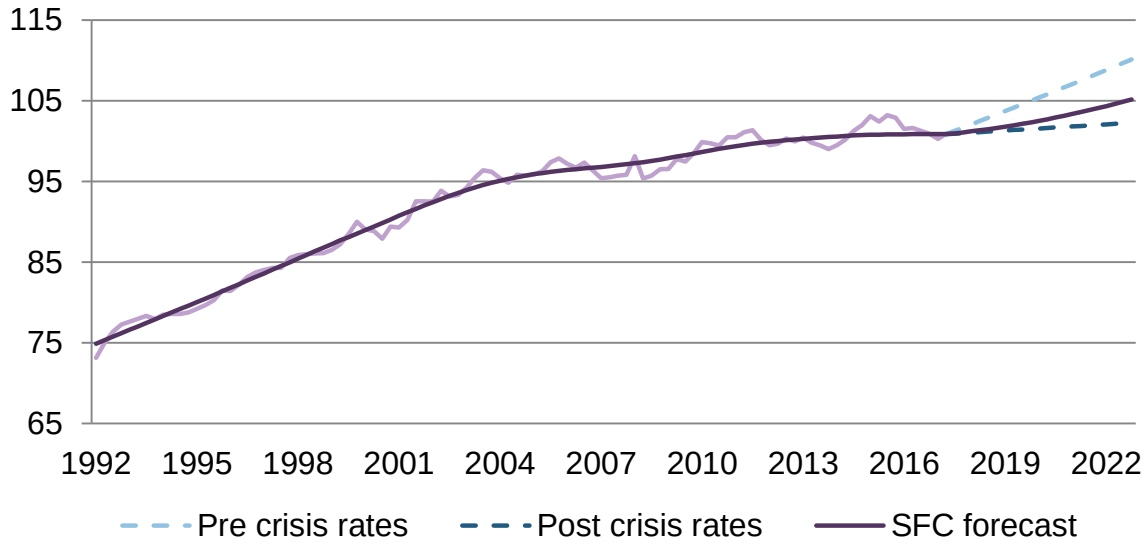
4.57 On balance, the Commission believes that the slowdown in productivity growth observed since 2004 is becoming a long-term feature of the Scottish economy. Whilst this does not necessarily mean that productivity growth will be permanently lower in Scotland, we do not see this trend reversing rapidly within our five year forecast horizon. Broadly, we assume that the trends in productivity growth observed over the last seven years will continue in the next five years.

4.58 The Commission’s forecast is a balance between recent observations and longer-term trends. Our judgment is that trend productivity growth will gradually increase from an annual 0.5 per cent in 2018-19 to 1.0 per cent in 2022-23.

*Forecast*

4.59 Based on our judgement, Figure 4.28 shows the Commission’s forecast of productivity.

**Figure 4.28: Scottish trend productivity projection, Index 2014 = 100**

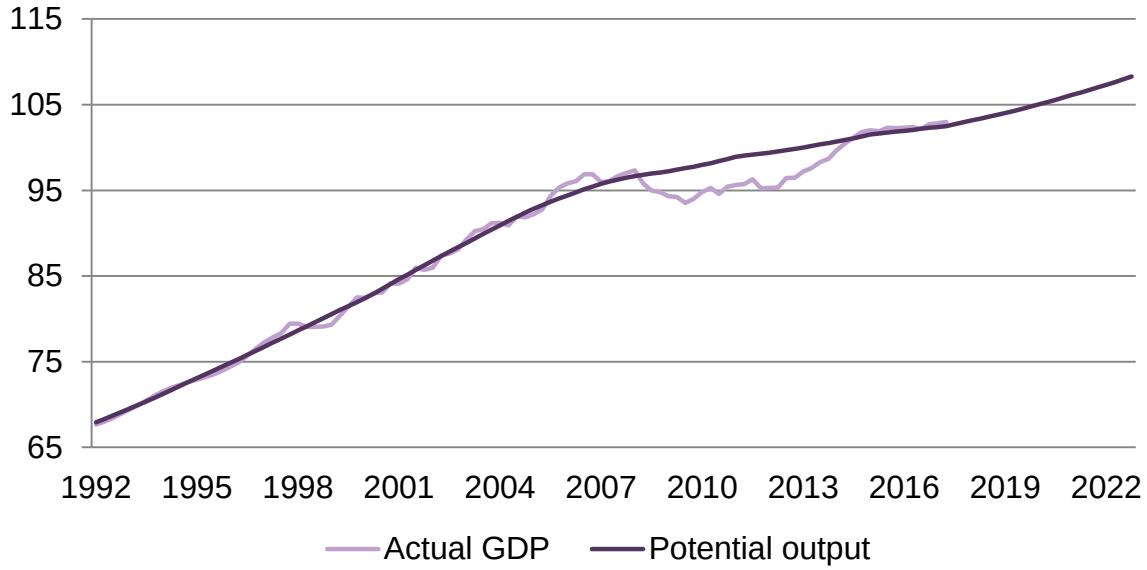



Source: Scottish Fiscal Commission

# Section 5: Forecasts of potential output

5.1 Once all the components of potential output have been forecast, the last step is to bring the components together as described in Figure 3.1. Figure 5.1 shows the resulting forecast of potential output.

**Figure 5.1: Potential output projections, Index (2014 = 100)**



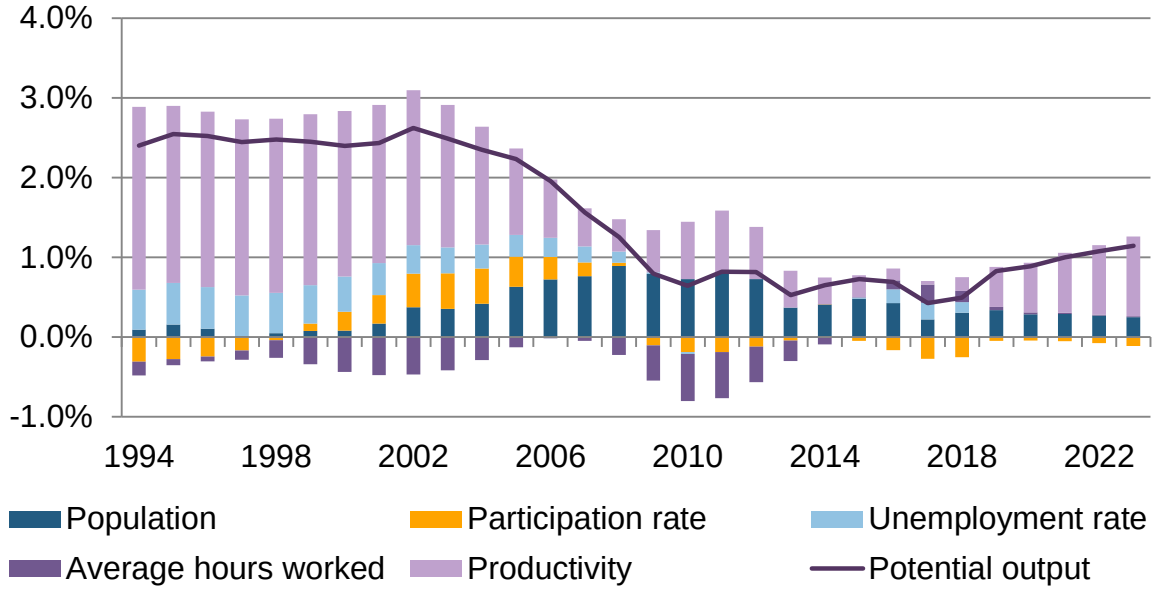

Source: Scottish Fiscal Commission

## Decomposition of potential output growth

5.2 Given our forecasting approach, it is possible to decompose growth in potential output by each of the components described above: population, participation rate, unemployment rate, average hours and labour productivity. This decomposition is shown in Figure 5.2.

5.3 The main drivers of growth in potential output in our forecast of Scotland are productivity and population. The remaining components have a relatively smaller effect and are expected to be more stable over the forecast horizon.

**Figure 5.2: Potential output growth decomposition, %**




Source: Scottish Fiscal Commission

5.4 While participation and unemployment rates have positively contributed to growth in potential output since the 1990s, they are not expected to positively contribute to potential output in our forecast period. We do not expect the trend unemployment rate to continue to decrease and participation rates are expected to slightly decrease because of the ageing of the Scottish population.

# Section 6: The output gap

## Overview

6.1 The output gap is the difference between estimated potential output and the actual level of output at a point in time. This is an indication of the degree of overheating or slack of the economy relative to its productive capacity. One general forecasting judgement is that the output gap should close over the long-run as markets adjust.

6.2 If the economy is operating below capacity with a negative output gap, there is room for faster growth in the short-term to catch-up with potential. If on the other hand the economy is already operating above capacity, this will restrict the outlook for growth.

6.3 The output gap is not observable and its estimation is subject to uncertainty. There are multiple methodologies for estimating the output gap for an economy. These range from simple empirical based univariate methods to richer multivariate methods incorporating a range of economic variables.

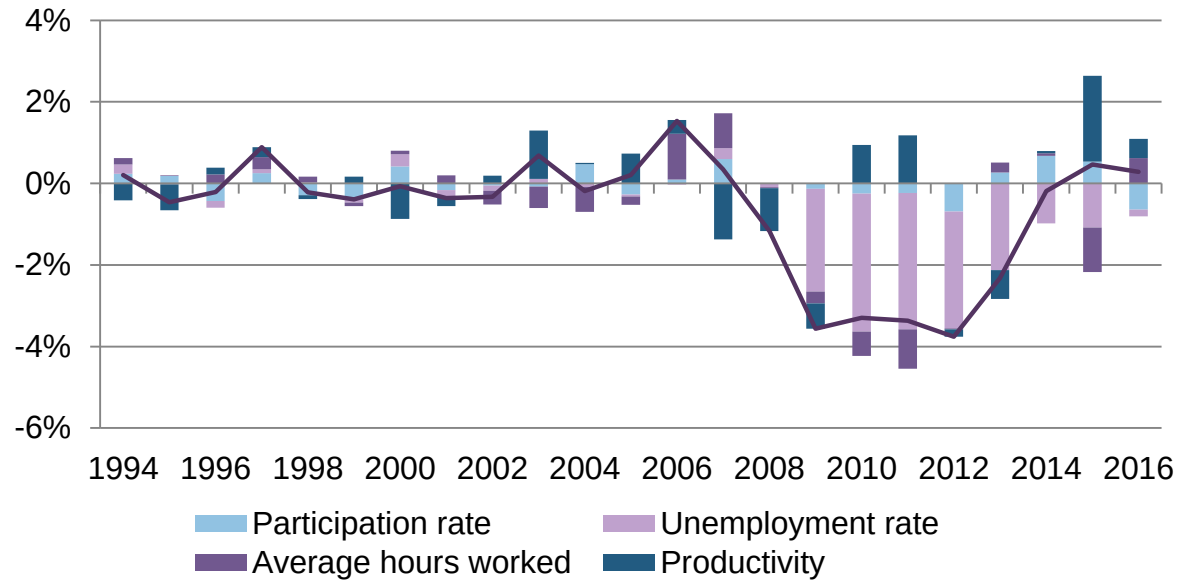
6.4 The Commission obtains its primary estimates of the output gap through comparing actual output relative to our potential output estimates outlined above. We consider various business surveys covering spare capacity in the economy, and combine these indicators together to provide a secondary estimate of the output gap, which we call our cyclical indicators approach.

## Production function approach

6.5 With this approach, the output gap is the percentage difference between the Commission's estimates of potential and actual GDP.

6.6 This approach incorporates a number of important and emerging economic trends that feed in to our wider approach to forecasting. By producing such a bottom-up estimate of potential output we are able to identify and decompose how the various components of potential output contribute to our output gap. Figure 6.1 shows how participation, unemployment, average hours and productivity all contribute to the estimated output gap.

**Figure 6.1: Output gap decomposition, %**




Source: Scottish Fiscal Commission

6.7 The economy was operating below capacity for much of the period 2008 to 2014, and most of this slack was in the labour market, with unemployment rates significantly above where we believe the trend rate was. We also believe that, over this period of time, there was some slack in the number of hours individuals worked, particularly in respect of part-time workers who would have been willing to work more hours or take full-time jobs.

6.8 In 2016, the latest full year for which data are available, we think the Scottish economy was broadly at capacity. The unemployment rate was slightly below trend, which will restrict growth in the near future. Similarly, rapid increases in the participation rate will mean limited room for further growth from the labour market. Offsetting this, we think average hours worked were below their trend, which may allow a slight increase in hours worked to contribute to growth in the near future.

## Cyclical indicators approach

6.9 By combining survey data indicating capacity utilisation using appropriate weights, we can generate an indicator of the output gap in Scotland. For this, we use Scotland specific surveys such as the Scottish PMI or Scottish Chambers of Commerce, as well as UK wide indicators from the Bank of England and the CBI.

6.10 While we place more weight on our production function approach, analysis of cyclical indicators complements the Commission's view on the output gap.

6.11 The Commission's methodology for the cyclical indicators approach can be summarised as:

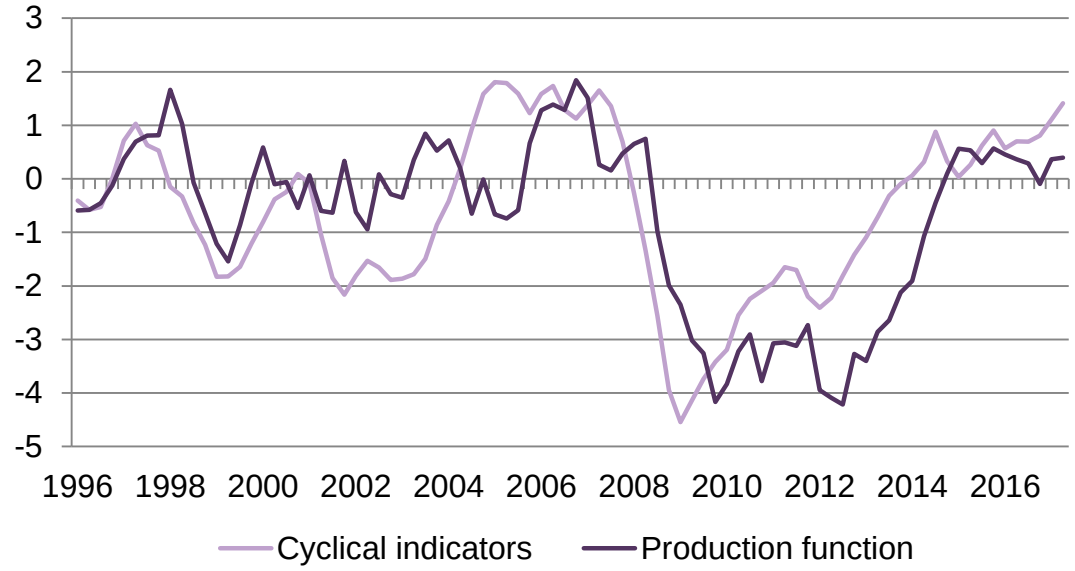
- The results from each indicator of capacity surveys are standardised so that they can be consistently combined. This is done respective to the historic average and standard errors.
- These standardised indicators of capacity are then combined using appropriate weights. This includes industry weights or whether the survey refers to labour or capital shares. This results in an aggregate standardised indicator for the output gap.
- Finally, the Commission determines the mean and standard deviation to impose to the standardised indicator of the output gap. The Commission considers the distribution of the production function output gap estimates over the same time frame provides the most appropriate indicator.

6.12 The surveys used collect qualitative rather than quantitative information, usually based on the number of firms responding to binary questions on capacity shortage. This gives an indication of the number of firms facing capacity shortages, but it does not necessarily indicate the intensity of the shortage. The surveys are also somewhat limited in scope for Scotland. We therefore use evidence from the cyclical indicators approach as an additional source of information to complement our production function derived estimates.

6.13 Figure 6.2 compares the two estimates of the output gap in Scotland. Whilst derived from different methodologies and data, the two approaches provide broadly similar estimates. This gives us greater confidence in our production function approach to estimating potential output. Whilst our production function approach suggests that the Scottish economy was broadly on trend in the latest quarter with a small but positive output gap of +0.4 per cent, surveys of the Scottish economy are suggesting that the economy is now over capacity, with an output gap of +1.4 per cent.

6.14 Both approaches indicate a positive output gap for Scotland, implying that there has been a structural slowdown in economic growth.

**Figure 6.2: Output gap estimation methodology comparison, (%)**




Source: Scottish Fiscal Commission

# Annex 1: Generation of industry productivity figures

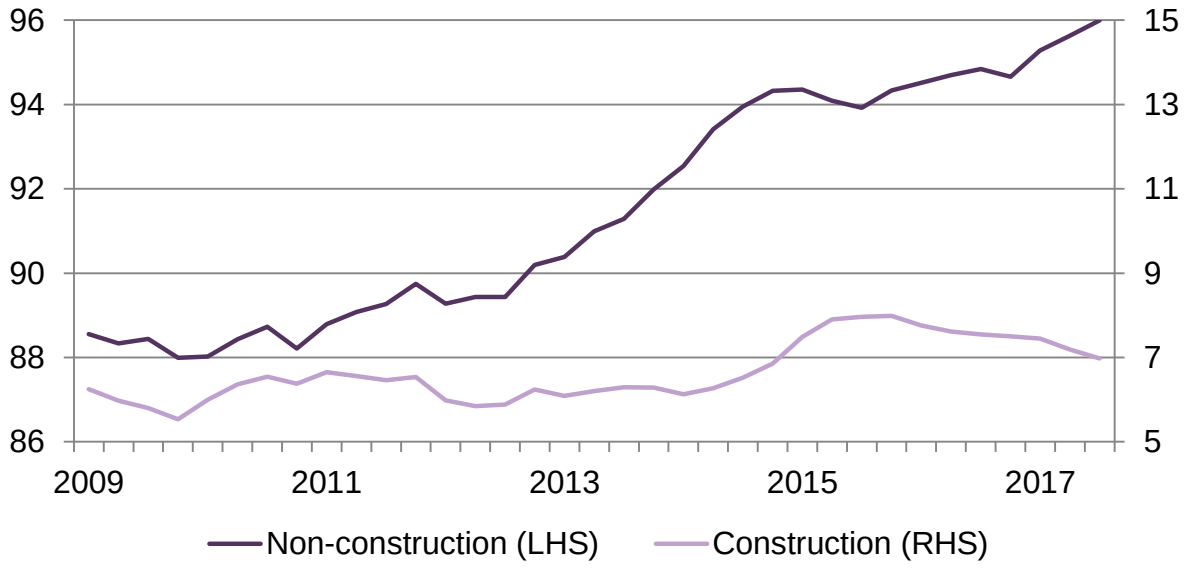
A.1 The Commission decomposes its productivity figures between the construction and non-construction industries. Through this decomposition, the Commission aims to account for the temporary boom in the construction industry in 2014.

A.2 For this, the Commission decomposes and combines the trend component of both the construction and non-construction industries. The methodology for obtaining this is described below.

*1. Generate weighted industry GDP series*

A.3 We multiply the construction and non-construction output indices with their respective weights in total output. These weighted indices are shown in Figure A.1.

**Figure A.1: Weighted industry GDP, Index (2014 Total GDP = 100)**



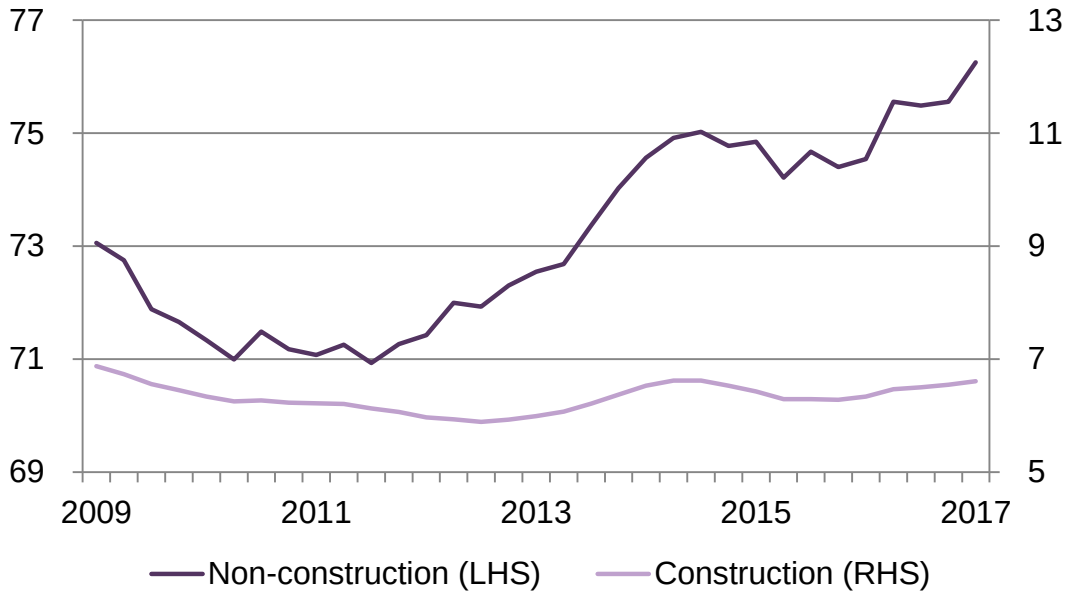

Source: Scottish Fiscal Commission

A.4 Figure A.1 illustrates how the construction industry significantly supported GDP growth in 2014, but it has acted as a drag to GDP growth since then.

*2. Generate quarterly industry hours series*

A.5 Total APS hours are combined with the industry shares of total hours worked given by the ONS regional productivity hours series. This is shown Figure A.2.

**Figure A.2: Total hours worked in the Construction and non-construction industry, millions**




Source: Scottish Fiscal Commission

*3. Generate productivity series that are comparable across industries*

A.6 We divide weighted industry GDP series by the industry hours series for both the construction and non-construction industries. These are the actuals values in Figures A.3 and A.4.

*4. Generate trend values for productivity across industries*

A.7 We use an HP filter – a way of smoothing data - for the non-construction industry productivity, while we apply a constant productivity during and after the construction boom, as indicated by the trend lines in Figures A.3 and A.4.

**Figure A.3: Productivity excluding the construction industry**

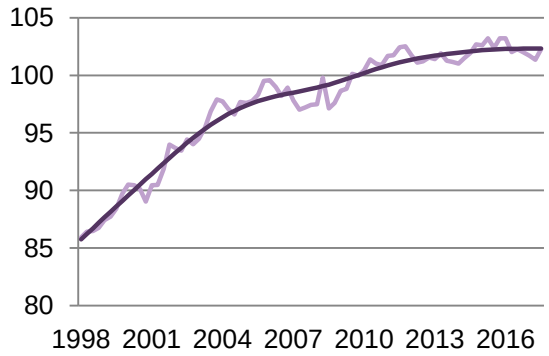
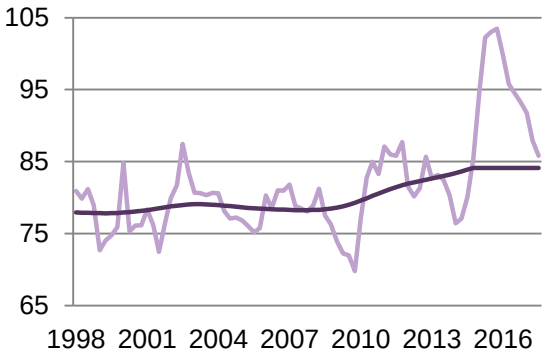
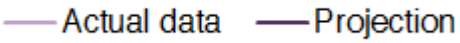



**Figure A.4: Productivity in the construction industry**




Source: Scottish Fiscal Commission

*5. Generate industry productivity weights*

A.8 We calculate the productivity weights of the construction industry productivity that allow us to combine the construction and non-construction industry into aggregate productivity. These weights come from the following expression.

$$Prod(Total) = w(Cons) * Prod(Cons) + \big(1 - w(Cons)\big) * Prod(NCons)$$

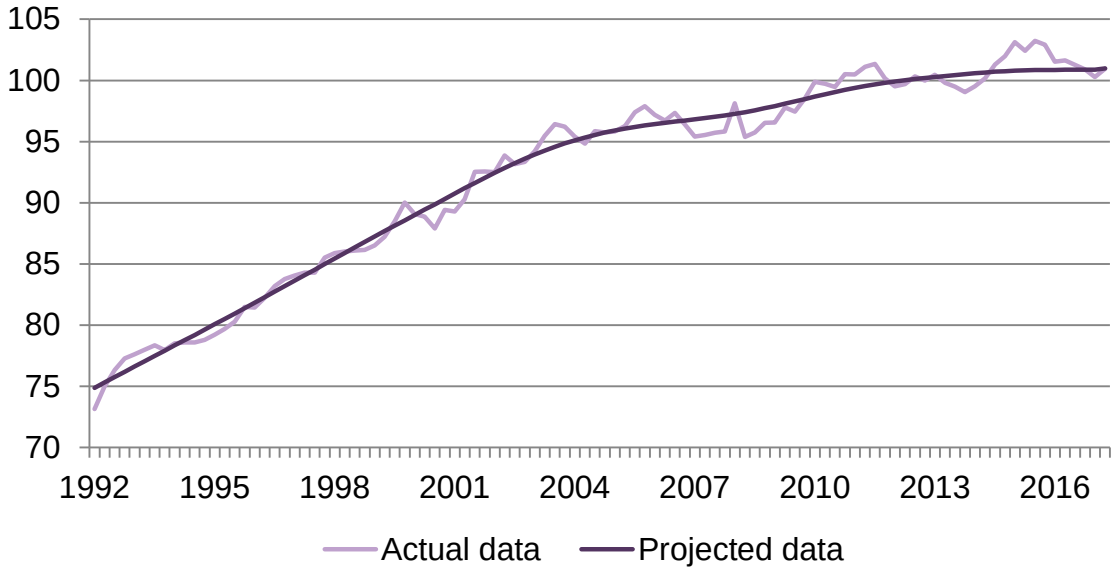
A.9 This gives us:

$$w(Cons) = \frac{Prod(Total) - Prod(NCons)}{Prod(Cons) - Prod(Ncons)}$$

*6. Generate trend productivity series:*

A.10 We combine the construction and non-construction industry productivity figures with their respective weights to obtain the aggregate trend productivity series illustrated in Figure A.5.

**Figure A.5: Actual and trend productivity, Index 2014 = 100**

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