Home Office

Technical paper to accompany the 'The UK's future skills-based immigration system' economic appraisal: Annex B

December 2018

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Introduction

1. This Technical Annex accompanies the Economic Appraisal of the UK's Future Skills Based Immigration System White Paper and provides more information on the methodology and data sources behind the modelling provided in Section E of the Economic Appraisal, which considers potential impacts on long-term EEA work migration that could result from the modelled salary and skilled threshold under a skilled work route.

2. The analysis presented here is designed to give an initial view of the potential scale of some of the impacts, and wider considerations. The modelling is based on the introduction of a £30,000 salary threshold and RQF 3 skills threshold for long-term EEA migrants. The future migration policy may, however, vary salary thresholds across occupations or for some groups – there will be discussions with businesses and employers on the appropriate threshold. For example, the threshold could be reduced for occupations in shortage, or for new graduates as in the current Tier 2 system.

3. This Technical Annex begins by setting out the methodology behind the 'baseline' projection of EEA work migration (independent of any policy changes) which underpins the estimates of the impacts. We then present the assumptions behind the migration policy model used to estimate changes in the level of net migration resulting from policy changes. Following that, we show how changes to net migration are translated into impacts on GDP, GDP per capita and fiscal balances, including the detailed assumptions behind these estimates. The final section sets out our analysis of potential labour market adjustments, identifying areas of the labour market which may face challenges.

4. The Economic Appraisal of the White Paper discusses the underlying uncertainty behind the estimates in detail. There are several ways which the uncertainty in the analysis manifests itself:

   - **Data sources** – imperfect data (such as the use of survey data) often mean that confidence intervals can be large;
   - **Assumptions** – any modelling requires the use of evidence-based assumptions and expert judgement and migration is no exception; and
   - **Behavioural response and change** – predicting response or changes to behaviour can be highly uncertain.

5. The potential impacts should be considered in the context of this uncertainty and treated as orders of magnitude rather than precise estimates. We have provided ranges around all estimates, which we discuss in more detail within the first section of this annex.

Modelling a counterfactual – EEA work-related migration

6. To provide an understanding of the impact of policy choices on migration flows it is important to be able to compare options with one another on a like for like basis. In practice this means that there must be a common "baseline" of EEA migration against which to judge alternative outcomes.

7. Projecting migration flows is extremely challenging for a number of reasons:

   (i) There are a wide range of potential drivers, which are themselves inherently uncertain. Migration flows are subject to short term "shocks" that by their nature are unpredictable.
   (ii) There are significant limitations of the underlying data.
   (iii) Using statistical techniques to project forward assumes that past behaviours and relationships between variables remain stable over time and will continue in the future. In reality, the world is ever changing, and behaviours will adapt and evolve over time in response to a changing environment.

8. The Migration Advisory Committee (MAC) migration forecasting report[1] discusses these challenges in more detail.

9. Any analysis of future migration flows should therefore be considered in this context and the high levels of uncertainty that this implies. Nonetheless, to provide an understanding of the impact of policy choices on economic outcomes it is important to be able to compare options with one another on a like for like basis. To assess the impact of work route migration policy, we model long-term work-related EU flows into and out of the UK to create a counterfactual.

Inflows modelling

10. To project work-related migration inflows, we use an econometric model to quantify the relationship between inflows to the UK and demographic and economic factors. We base the model on factors that are cited as migration drivers in the existing literature, both for source countries and the UK, to capture both 'push' and 'pull' factors. This approach is consistent with previous empirical studies on migration[2].

[1] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/467405/Migration_Forecasting_report.pdf

[2] Ortega, F. and G. Peri (2009). The Causes and Effects of International Migration: Evidence from OECD Countries 1980-2005.
Forte, G. and Portes, J. (2017): Macroeconomic Determinants of International Migration to the UK, GLO Discussion Paper, No. 69

11. Demographic and economic factors used in the model include:

- population aged 20-39 (as most migrants are in this age bracket);
- relative unemployment rates; and
- relative GDP per capita (using a purchasing-power-parity exchange rate).[3]

Data

12. The model uses International Passenger Survey (IPS) data for annual inflows from 19 EU countries[4] between 2004 and 2015[5]. IPS data is adjusted for other inflows such as asylum seekers and flows to and from Northern Ireland to estimate Long-Term International Migration (LTIM) which are used as the main measure of immigration, emigration and net migration across the whole population. As LTIM estimates are not provided by reason for migration and nationality, we use the unadjusted IPS estimates in our regression analysis[6]. As with all surveys, IPS is subject to sampling variability and since international migration estimates are based on a relatively small number of interviews some variables can only be disaggregated to a certain level before being subject to unacceptable margins of error, for example, migration from certain countries by single year.

13. Figure 1 below illustrates EU work-related inflows to the UK between 1991 and 2017. It suggests that inflows have responded to policy changes (such as the accession of EU8 and EU2 countries), but also are likely to reflect underlying economic conditions such as the global financial crisis and the onset of the Eurozone debt crisis in 2010.

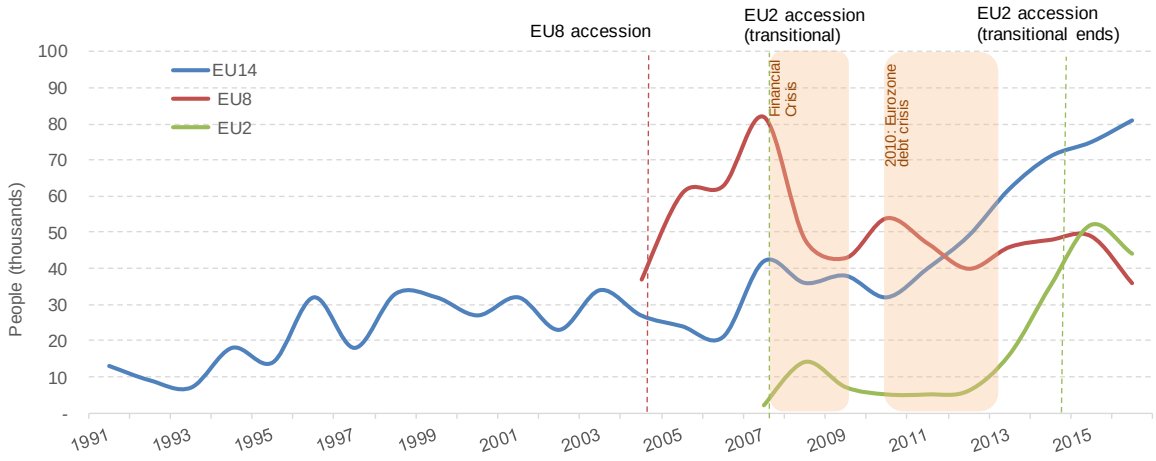
[3] In the IMF WEO online database, the implied PPP conversion rate is expressed as national currency per current international dollar. Projections for GDP in current prices (converted in PPS) are available at: https://www.imf.org/external/pubs/ft/weo/2018/02/weodata/index.aspx

[4] The EU countries not included in the sample are: Ireland, Luxembourg, Cyprus, Malta, Slovenia, Romania, Bulgaria and Croatia, reflecting data availability. Romania and Bulgaria are excluded as they were subject to migration controls for most of the sample. In addition, migration controls remained in place for Romania and Bulgaria until 2014. The projections assume that migration flows from all EU countries respond to the demographic and economic determinants according to the estimated regression coefficients.

[5] IPS estimates at country level are available from 2000 and we opt to use this level of granularity to capture the most recent migration trends, foregoing a longer but more aggregated time series (from 1991).

[6] We do however make a final adjustment to projections to account for the estimated work-related portion of the LTIM adjustment.

Figure 1: Work-related inflows from EU14, EU8 and EU2 respectively[7]



Model specification

14. The model specification uses traditional panel data modelling techniques to project baseline migration inflows. The functional form utilised is[8]:

(1) $y_{it} = \beta_0 + X'_{it}\beta + u_{it}$, where X' is a vector of economic variables[9] for each country i at time t.

15. The final model yields[10]:

(2) $y_{it} = -0.9 - 1.8rel\_gdp_{it-1} + 0.1unemp\_diff_{it-1} + 0.1\Delta unemp\_diff_{it} + e_{it}$

Where:

- y is the natural logarithm of rate of EU inflows to the UK as a percentage of the population aged between 20 and 39 in country i
- $unemp\_diff$ is the difference between country i and UK unemployment rate, lagged by one year;
- rel_gdp is the ratio of the natural logarithm of GDP between country i and the UK, lagged by one year;
- e is the average error.

[7] International Passenger Survey Table 3.08. EU15 countries include Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain and Sweden. EU8 countries include the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, the Slovak Republic and Slovenia. EU2 countries include Bulgaria and Romania.

[8] We use 'random effects' rather than 'fixed effects' to cater for the persistence of differences between relative income which could appear as fixed effects.

[9] https://www.imf.org/external/pubs/ft/weo/2017/01/weodata/index.aspx

[10] Alternative specifications were included to test the effect of exchange rate and inequality measured by GINI coefficients but were not found to be significant in explaining long term migration flows. Note that exchange rates will affect relative incomes – which are included. Model gives an overall R squared of around 0.5. All coefficients are significant at p<0.01.

16. The key quantified relationships from this are:

- *A 1% change in relative GDP between EU countries and UK results in a -1.8% change in the work-related inflows.*
- *A 1ppt change in the difference between unemployment rates results in a 10% change in work-related inflows.*
- *A 1ppt change in the growth rate of the difference between unemployment rates results in a 10% change in work-related inflows.*
- *A 1% increase in population aged 20-39 in the origin country results in a 1% increase in work-related inflows.*

17. Having derived an estimate for the economic and demographic drivers of inflows from the EU, the estimates are then applied to forecast macroeconomic variables from the International Monetary Fund (IMF) World Economic Outlook (WEO)[11] to project EU migration flows until 2023. For the UK, pre-referendum (April 2016[12]) WEO projections of GDP and unemployment are used – this is in line with the Government's EU Exit Analysis. For all other EEA countries, it is assumed that any impacts of UK's EU membership referendum on the GDP and unemployment of other EU economies is limited. We therefore use the latest data available (October 2018[13]).

18. After 2023, relative GDP per capita is assumed to remain at its 2023 level for the EU15. For EU8 and EU2 economies the speed of convergence with the UK is assumed to decelerate[14]. Population projections, beyond 2023, by country and age are sourced from United Nations Population Projections[15].

19. The migration data used as a basis for the projection is the three-year average of the inflows between 2013 and 2015. A three-year period was chosen to capture inflows following EU2 accession years but avoid placing too much weight on single data points. We do not include any data points after the EU Exit referendum to capture the full effects of EU Exit.

Results, uncertainty and sensitivity

20. The migration estimates used for the baseline projections show EU work-related inflows decreasing over time in the absence of policy intervention or other outcomes caused by EU Exit (Figure 2). This reflects projected demographic and economic

[11] In the IMF WEO online database, the implied PPP conversion rate is expressed as national currency per current international dollar. Projections for GDP in current prices (converted in PPS) are available at: https://www.imf.org/external/pubs/ft/weo/2018/02/weodata/index.aspx

[12] https://www.imf.org/external/pubs/ft/weo/2016/01/weodata/weoselgr.aspx

[13] https://www.imf.org/external/pubs/ft/weo/2018/02/weodata/index.aspx

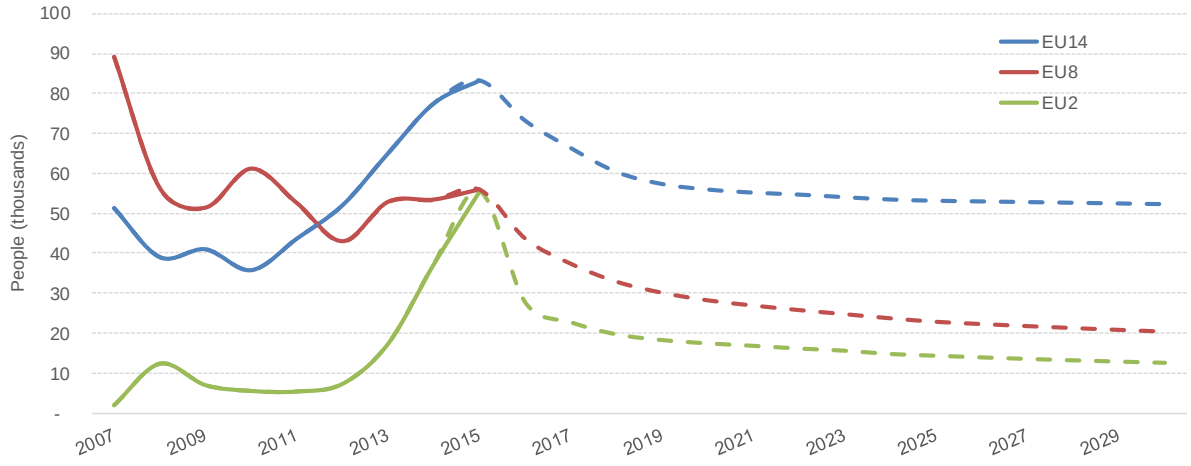
[14] EU8 and EU2 countries are assumed to continue to grow but at 80% of the previous year's growth rate.

[15] https://population.un.org/wpp/Download/Standard/Population/

trends such as a decline in the working age population and a narrowing gap in the income levels between the UK and other EU countries.

21. As stated above, there is a significant amount of uncertainty surrounding any estimates of future migration flows. The projections here should not be treated as a forecast – instead they reflect a plausible future profile consistent with a set of future long-run fundamentals, which can be used to compare policy changes against.

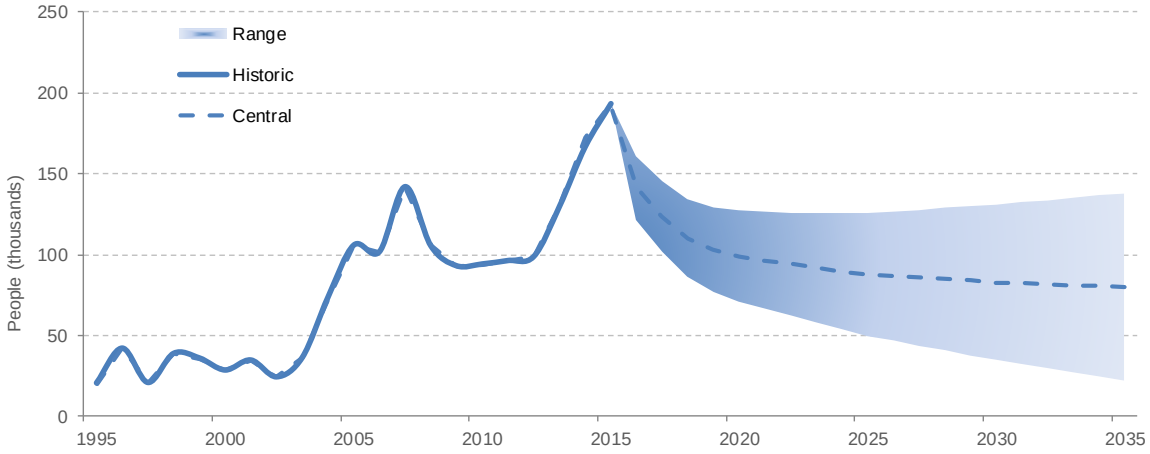
Figure 2: Historic long-term work-related inflows from EU14, EU8 and EU2 and projections[16]



22. To illustrate the uncertainty around the central estimates, ranges have been estimated using the "average" (root mean squared) prediction errors for EU inflows from equation (2). The ranges are set at +/-20,000 respectively but are assumed to widen over time at a rate of +/- 2,000[17] each year to reflect the concept that uncertainty compounds over time (Figure 3).

[16] *Home Office analysis* - based on IPS historic data with a final adjustment made for the estimated work-related portion of the LTIM adjustment (which includes other inflows such as asylum seekers and flows to and from Northern Ireland).
[17] Based on +/- 10% of root mean squared error

Figure 3*:* Central range around projected long-term EEA work-related inflows[18]



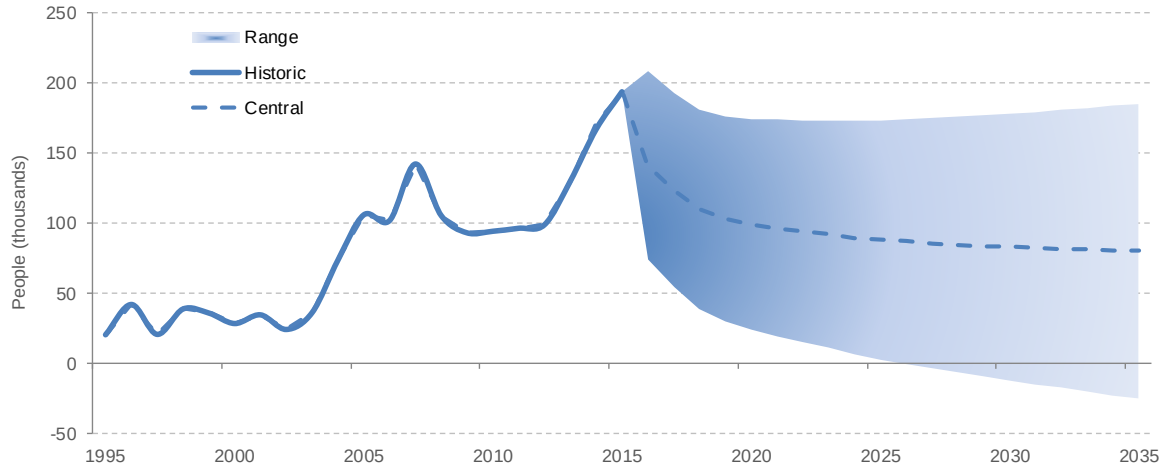
23. Root mean squared error (RMSE) is a measure of how accurately the model predicted observed inflows and illustrates how far out the projection might be based only on how well the model predicted historic data points (using outturn data for economic and demographic drivers). This only captures one element of the uncertainty within our model. However, there are additional sources of uncertainty:

- Uncertainty in underlying outturn data;
- Uncertainty in projected fundamentals (for example, projected unemployment rates and relative GDP); and
- Uncertainty over time and stability of relationships between inflows and drivers of migration

24. Another approach to illustrate the uncertainty around projections is to consider the variation in the time series of EU work-related inflows over time, by measuring the standard deviation of EU inflows (between 2005 and 2015). We can produce an illustrative range around our projection of two standard deviations either side of our central projection. This results in a range of +/-70,000, and we apply the same judgement as before, and grow the range by 2,000 every year to reflect how uncertainty compounds over time. This range is purely illustrative, it is intended to reflect the historic tendency of inflows to change significantly over time and highlights the need to consider estimates within the context of uncertainty. Although much wider, the range still does not capture the full extent of uncertainty within projections.

[18] To estimate the final EEA projection estimated inflows from Norway and Switzerland are added to EU2, EU 8 and EU14 projections and inflows from Ireland are removed. Due to small volumes we do not project inflows from Norway, Switzerland and Ireland econometrically- instead we assume volumes remain stable as a proportion of EU14 inflows over 2011-15.

Figure 4: Illustrative uncertainty based on 2 standard deviations around historic long-term EEA work-related inflows



Sensitivity analyses

25. Projections are dependent on several key assumptions such as model specification, the coefficients used, and the reference period chosen. We have conducted sensitivity analyses to illustrate how the results vary when changing the assumptions (see Figure 5).

Figure 5: Sensitivity of projected inflows to alternative assumptions

	Coefficients used		Annual average inflows ('000s)		
			2021-2025	2026-2030	2031-2035
Migration Baseline Inflows (central estimate)	rel_GDP	-1.80	92	85	81
	UNEMP_diff	0.10			
	ΔUNEMP_dif	0.10			
Alternative coefficients (95th CI)	Coefficients used		Change from central estimates		
			2021-2025	2026-2035	2031-2035
A1 95th confidence intervals[19] for relative income	rel_GDP	-2.66	-7%	-7%	-7%
	rel_GDP	-0.99	8%	9%	9%
A2 95th confidence intervals for relative unemployment	UNEMP_diff	0.03	12%	13%	13%
	UNEMP_diff	0.13	-11%	-11%	-11%
A3 95th confidence intervals for unemployment difference	ΔUNEMP_dif	0.03	4%	4%	4%
	ΔUNEMP_dif	0.18	-4%	-4%	-4%
Alternative reference periods:			2021-2025	2026-2035	2031-2035
A5 5-year reference period (2011-2015)			-14%	-14%	-14%
A6 5-year reference period (2013-2017)			6%	6%	6%

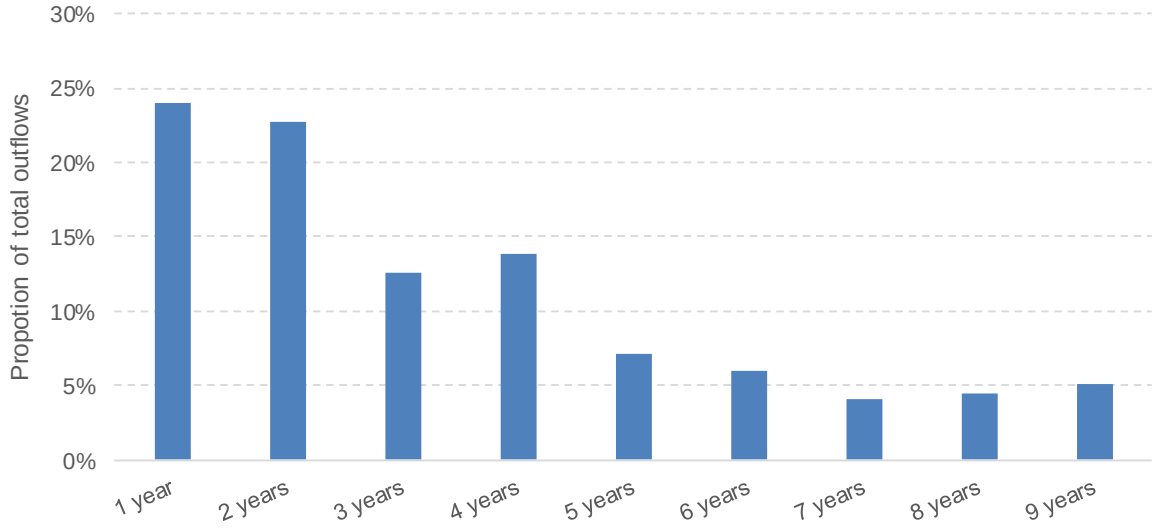
Outflows modelling

26. To capture net migrant workers in the economy, we model outflows as a function of previous inflows. To link outflows to previous inflows we have reviewed the Office for National Statistics (ONS) estimates of long-term EEA emigrants by year of

[19] Implies there is 95% probability that the calculated confidence interval (-2.66 to -0.99) encompasses the true value

previous arrival[20]. This provides data on year of arrival of outflows between 2005 and 2016. This allows the estimation of a nine-year profile for length of stay of outflows (averaged over 2013-15). Due to lack of data by individual year of arrival prior to 2005, the outflows profile beyond nine years cannot be estimated.

Figure 6: EU outflows by length of time in country across 2013-15[21]



27. This nine-year outflow profile is applied to historic EEA inflows; these results are then compared to actual outflow data to infer the proportion of EEA inflows who eventually left the UK. Based on this, we estimate that 40% of EEA inflows leave the UK within nine years. Given the data availability, all EU migrants who are estimated to leave the UK are assumed to do so within nine years of arrival.

28. This approach assumes the behaviour of EEA migrants in terms of the proportion choosing to stay in the UK and length of time in the UK remains stable over time and is constant across occupations, regions and sectors.

Net migration baseline – EEA work-related migration

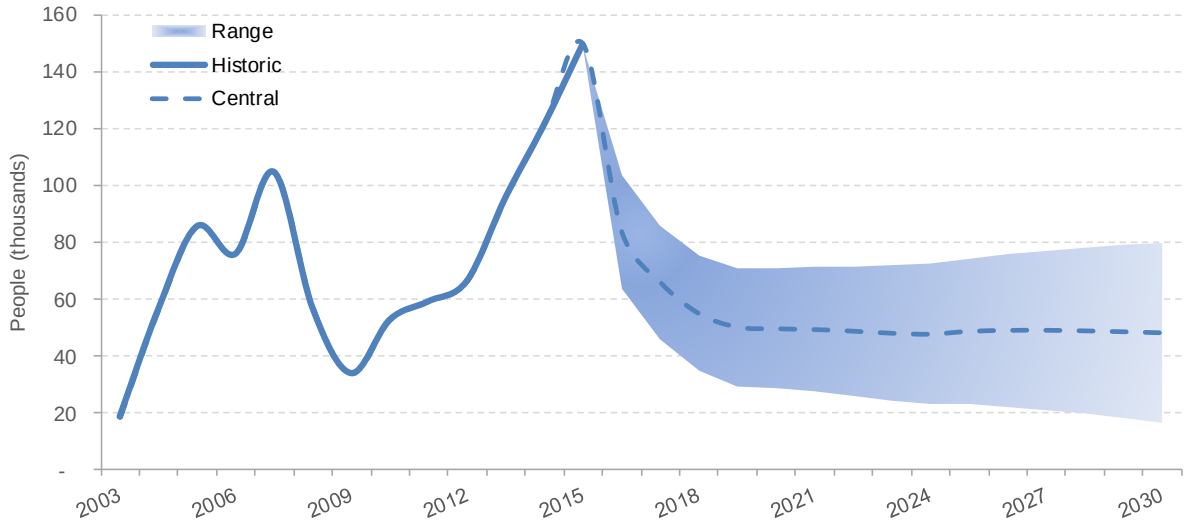
29. We combine inflow and outflow modelling to create a baseline for net long-term EEA work-related migration to the UK. This profile does not reflect a forecast and is an analytical tool to be able to consistently compare policy choices against one another and against a 'do nothing' option. Actual net migration will differ from this analysis.

[20] https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/internationalmigration/adhocs/007865internationalpassengersurveyestimatesoflongterminternationalemigrationfromtheukofformerimmigrantsbycitizenshipandyearofpreviousarrivalintheuk2005to2016

[21] HO analysis of IPS data link in footnote 8

30. Ranges around inflows described in paragraph 22 above are used to drive ranges around central estimates of net EEA work-related migration and subsequent ranges around economic impacts (GDP and fiscal impacts).

Figure 7: Historic and projected net long-term EEA work-related migration



Migration policy modelling

Model summary

31. The migration policy model uses data on inflows and on the current population of EU workers to estimate characteristics of future migration flows. It applies potential policy levers (such as skill / salary thresholds) to our baseline inflows to estimate the impact of these policy levers on the level of inflows, and on net migration.

32. For example, when modelling the impact of applying a specific salary threshold to enter the UK, the threshold is applied to the existing wage distribution of EEA migrants within each occupation, identifying the proportion within each occupation that would not meet the specified wage threshold.

33. A skill threshold is modelled using the required skill for each occupation set out in Immigration Rules Appendix J[22]. When a skill threshold policy lever is applied each occupation either meets the criteria or does not, the response is binary. Future inflows of immigrants in occupations that do not meet the required threshold are reduced to zero, while inflows to occupations that do are unaffected.

34. Outflows respond to previous inflows over a nine-year period as described above. When policies are imposed on worker inflows there will be a lagged response in outflows.

35. The model only captures long-term migration flows and is based on the simplifying assumption that there are no dynamic or behavioural responses following a migration policy change. We define long-term immigrants as those stating on entry to the UK that they intend to stay for 12 months or more. Short-term immigrants (those intending to stay for less than 12 months) are not currently captured in the analysis.

36. Using this analysis, we estimate an RQF 3 skills threshold and a £30,000 salary threshold could result in a reduction in long-term EEA inflows of around 80%. Applied to our baseline projection of long-term EEA worker inflows (shown in Figure 3) this could reduce inflows to between 10,000 and 25,000 per annum in the first five years of a policy (2021 to 2025). In terms of net work-related EEA migration, we estimate proposals could result in between 200,000 and 400,000 fewer long-term EEA workers by 2025.

[22] https://www.gov.uk/guidance/immigration-rules/immigration-rules-appendix-j-codes-of-practice-for-skilled-work

Data and assumptions

Employment characteristics

37. The IPS data on inflows includes information on whether a migrant is a worker or a dependant and their age profile. IPS data does not include information on the employment characteristics of flows; we therefore use stock data to help inform where EEA workers might decide to work when they arrive in the UK, and their salaries. Given the use of stock data, a key caveat to this model is the need to assume that the characteristics of the stock of EEA nationals are a reasonable proxy for the future flows of EEA nationals, in the absence of any policy change. We use the Annual Population Survey (APS) pooled dataset (2014 – 2016) to estimate the current occupation (four-digit SOC[23]) and sector split for EEA migrants.

38. Population data for EEA workers (from the APS pooled data set) is also used to estimate the regional distribution of EEA nationals across occupations. This is combined with regional differences in pay to estimate regional impacts of policy scenarios.

39. For simplicity, it is assumed that the occupational distribution across sectors and regions stays the same over time – apart from changes that occur as a result of applying salary or skills-based restrictions. Sensitivity analysis has been done to consider the impacts of changing the occupational composition with no significant impact on the results.

Wages

40. In the absence of reliable data on the wages of migrant flows, the wage distribution of the existing stock is used as a proxy for future flows. This may overstate the wages of new inflows, as EEA migrants are likely to progress through the wage distribution over time.

41. The wage distribution of the migrant stock is derived from the Annual Survey of Hourly Earnings (ASHE) 2016[24] data on earnings within occupations at 4-digit SOC and the occupational profile of EEA migrants (derived from APS 2014-16 data).

42. ASHE data does not differentiate between nationality, and therefore the modelling assumes that in each given four-digit occupation, workers of different nationalities have the same average wage; wage differentials are only driven by differences in

[23] The standard occupational classification (SOC) is a common classification of occupational information in the UK. There are nine major SOC groups (1-digit SOC codes), 25 sub-major groups (2-digit SOC codes), 90 minor groups (3-digit SOC codes) and 369 unit groups (4-digit SOC codes).

[24] Annual Survey of Hourly Earnings is a comprehensive source of earnings data in the UK using a representative sample of PAYE records of both full-time and part-time employees

the occupational distribution. This may not hold true as EEA workers are generally younger than UK workers, and hence likely to earn less. Previous analysis found some evidence of a wage penalty for EEA workers, for example, the MAC 2018 interim report on the impact of EEA nationals.[25]

43. The salary of each occupation at four-digit level is assumed to be equal across all industry sectors. In practice, it is likely that (even at this granular occupational level) workers doing similar jobs in different sectors will be paid differently.

44. Part-time workers wages are calculated at a gross annual rate, the rationale behind this being that any salary threshold would apply to a worker's total earnings as opposed to their pro-rata pay. This means that a mixture of full-time and part-time workers will be affected by salary restrictions at any given level.

45. The wages of current migrant stock and the salary threshold imposed on new flows are expressed in current prices. It also assumes the current stock of migrants is representative of the future migrant flows. This creates an implicit assumption that any imposed salary threshold will increase in line with any wage growth seen in the migrant stock.

46. Regional variance in pay for occupations have been included to estimate the regional impact of salary thresholds. We assume two major regional differences in pay[26]; 'London and the South East' and 'Other UK Regions'[27]. From this, the proportion affected for each region is determined by a mix of the regional distribution of EEA nationals within occupations and regional pay differences for occupations.

Dependants

47. The number of EEA dependants is estimated based on the average ratio of dependants to workers observed in the IPS data between 2013 and 2015. The data indicates a dependant ratio of 0.13 (i.e. for every eight workers one dependant is brought).[28] This dependants ratio has been relatively stable over time, therefore, our projections assumes this stays constant over time and across scenarios.

[25] The recent interim report published the Migration Advisory Committee found a 5% wage gap between migrants from the New Member States and the UK-born – after controlling for industry, tenure and region. Non-EEA migrants were also found to earn 6% less than the UK-born whilst workers from EEA13 had no significant difference from pay of UK born workers.

[26] ASHE 2016 suggests variation in average weekly earnings between London and the South East and Other UK Regions, but little pay variation between other UK regions.

[27] North East, North West, Yorkshire and the Humber, East Midlands, West Midlands, East, London, South East, South West, Northern Ireland, Scotland and Wales

[28] A small portion of the LTIM inflows are attributable to 'Others' for whom it is not clear how they would act in the UK. For the purposes of this modelling, they have been apportioned proportionally across workers and dependants.

48. Dependants include working dependants, non-working dependants and children. To estimate the proportion of dependants that are children, we use flow data from the IPS. Using a three-year average between 2013 and 2015 we estimate that children comprise 39% of all accompanying dependants.

49. Data on flows of migrants does not further break down accompanying/joining migrants by economic activity, but to consider the total labour market impact we need to estimate the total number of working dependants in any given scenario. We use data on the stock of EEA nationals who came as dependants between 2012 and 2016 from the 2016 APS[29]; this implies an activity rate of 58% for EEA dependants. This rate is then applied to IPS flows of adult dependants to give a full breakdown.

50. This process leads to 35% of dependants who are assumed to be workers, 26% who are assumed to be inactive, with 39% deemed to be children.[30]

51. A Wage penalty has been applied for EEA working dependants. We use data from the 2016 APS to find the difference in average weekly earnings between EEA nationals who said their reason for migrating was for work and those who came to accompany/join. We apply the income differential to estimated earnings of EEA working dependants.

Outflows distribution

52. It is assumed that outflows have a similar age and wage distribution as the current stock of EEA nationals, even when a policy is applied to inflows.

53. We assume under any particular scenario there is no change to the behaviour of EEA migrants in terms of the proportion choosing to stay in the UK and length of time they are here. This means that outflows take some time to adjust to lower inflows.

[29] We are unable to review reason for migrating in the pooled 2014-16 APS data so must use 2016 data only

[30] A worked example. If 800 workers arrive in any given year, then there will be 100 dependants accompanying these workers. These dependants will consist of 39 children. 58% of remaining dependants are assumed to be working, giving 35 working dependants, and 26% of all dependants are assumed to be inactive giving 26 inactive dependants.

GDP impacts of changes in migration

Labour supply impacts

54. Economic output is a function of labour used and capital employed (and how they combine with each other, land use and technology). Each worker is a unit of labour and therefore contributes to the creation of economic output. If all else is equal, lower work immigration means fewer workers in the economy and therefore lower economic output.

55. Using projections of the size of the UK's workforce in future years we can estimate the labour supply impact of changes in migration. We can then estimate the impact this change in labour supply could have on economic output and GDP per capita using an estimate of the future total UK population. Any estimated impact is highly uncertain and will depend on the interaction of a host of other factors.

56. The model has three components:

- Base stock of people in the UK in 2015 – projected over time using fertility and mortality rates.
- Projected workers' flows: net inflows into the UK for work reasons (from 2016 onwards).
- Projected non-workers' flows: net inflows into the UK for non-work reasons (from 2016 onwards).

57. Each component is projected separately over time, thus allowing estimation of how births, deaths and net migration affect total size of the population size in the future.

Data and assumptions

58. The total size of the population in 2015 is based on ONS outturn data. The population is then broken down by nationality, age and gender using APS analysis.

59. We follow ONS methodology and assumptions used in their population projections (excluding migration) to estimate the population projections by age and nationality. Births and deaths are estimated using 2016-based ONS mortality and fertility rates. The rates are assumed not to vary by nationality, in accordance with ONS methodology. Fertility rates are also assumed not vary between existing stock and new flows.

60. The number of people active in the labour market is then estimated using Labour Force Survey (LFS) participation and employment rates specific to each gender, age and nationality group. Over time, the analysis assumes that these rates grow in

line with the Office for Budget Responsibility's (OBR) assumptions in their 2018 Financial Stability Report (FSR) accounting for different growth rates by age group. The growth in the participation rate is not assumed to vary by nationality.

61. Net inflows of EEA workers and dependants are taken from our projections described above. Migration from the Rest-of-the-World (RoW), UK net migration and student net migration are assumed to stay constant at their 2013-15 average levels.

GDP and GDP per capita impacts

62. We use a production function to specify how labour supplied in each occupation contributes to output. We use a nested constant elasticity of substitution (CES) function. This expresses GDP as a combination of the output produced by the workforce employed in each main occupational group[31] (derived from the migration modelling described above). This can then be used to estimate the GDP impact of lower labour supply in specific occupations.

63. To estimate the reduction in GDP in the fifth year of a migration policy (2025), we calculate the reduction in total UK labour supply for each occupation group as a result of the modelled long-term migration policy. The reduction in the workforce is wage-adjusted, taking into account the wage shares of each occupation, using ASHE data. This is to reflect the higher proportion of EEA migrants working in lower skilled/ lower wage occupations.

64. This framework can be expressed mathematically as:

$$Y = Z^{1/\gamma}$$

Where:

$$Z = \sum_j^{\sigma} a_j L_j^{\gamma}$$

- Y denotes aggregate output;
- γ is a function of the elasticity of substitution between the occupations σ: $\gamma = \frac{(\sigma - 1)}{\sigma}$. A central value of 1.3 has been chosen for σ, which is consistent with values contained within wider cross government EU Exit modelling
- L_j is the workforce in occupation j
- a_j is the income share of occupation j.

[31] Using the nine ONS 1-digit SOC codes

65. Using this method, an elasticity of between 0.7 and 0.9 is estimated for a labour supply shock on GDP[32]. The elasticity depends on the skill mix of the EEA migrants and the specificities of the migration policy modelled. Under the modelled policy proposals for the skilled worker route which assume a skills and wage restriction on EEA workers, the GDP elasticity is around 0.7, as this policy predominantly leads to a reduction in the relatively lower skilled workforce.

66. As stated above, the modelled policy proposals under the skilled work route could lead to between 200,000 and 400,000 fewer long-term EEA workers by 2025. Our analysis suggests this represents a reduction in the UK labour force of between 0.6% and 1.3%, which, using the elasticity above, results in a reduction in GDP of between 0.4% and 0.9% in 2025.

67. In line with MAC recommendations, it is important to consider migration policy through impacts on GDP per capita. This is calculated using the percentage change in aggregate GDP (driven by the change in labour stock) and the percentage change in total UK population. The percentage change in labour stock is greater than the percentage change in the total UK population. We therefore see a smaller percentage reduction in GDP per capita than on aggregate GDP (see Figure 8).

Figure 8: Summary of GDP and GDP population impacts in 2025

Labour impact (%)	GDP impact (%)	Population impact (%)	GDP/capita impact (%)
0.6 - 1.3	0.4 - 0.9	0.3 - 0.7	0.1 - 0.2

68. Consistent with the rest of our modelling, impacts on GDP do not include any labour market adjustment. This means no assumption is made on the degree of reallocation of labour across the different occupations as a result of the loss in migrant output.

69. This modelling does not attempt to forecast the state of the economy in the future. This reduction in GDP just relates to the change against a baseline, not the absolute level of GDP.

Comparison with the literature

70. Several studies have looked at the GDP impacts of changing net migration levels from the EU (e.g., Lisenkova/NIESR, 2016[33] ; PWC/CBI, 2016[34]; OBR FSR[35]).

[32] Sensitivity analysis indicates that this ratio is not very sensitive to changes in the elasticity of substitution between each occupation in the production function.
[33] https://www.niesr.ac.uk/sites/default/files/publications/dp460.pdf (finds a ratio between 0.95 and 1 depending on scenario)
[34] http://www.cbi.org.uk/news/leaving-eu-would-cause-a-serious-shock-to-uk-economy-new-pwc-analysis/leaving-the-eu-implications-for-the-uk-economy/ (study found a ratio GDP-labour between 1.1 and 1.4 depending on scenario)

71. Most studies found that a percentage reduction in labour supply leads to a similar percentage fall in GDP, albeit the ratio differs between studies depending on the specificities of the assessed scenarios and the economic modelling assumptions (for example, the capital-labour ratio).

[35] OBR FSR (2018): Table 3.3 state that real GDP growth = productivity growth * employment growth. Given that productivity growth is constant in all their scenarios (most notably, their baseline, high migration, low migration and 50% EU migration scenarios), the % differences between the levels in real GDP in any given year between the scenarios are dependent solely on the % difference in employment size, i.e. a 1:1 ratio between % GDP loss and % change in employment.

Fiscal impact of EU migration

Overview

72. Migrants can contribute to and draw on the public purse, which has implications for the overall fiscal balance. Tax revenue and spending on migrants will depend on characteristics such as their income, age and economic activity. Therefore, changes in the volume or characteristics of migrants coming to live in the UK will have implications for fiscal balances, and this in turn will have implications for both current public funding and future spending decisions. We can assess this impact by considering the fiscal revenue (dependent on earnings) that one additional long-term migrant contributes and the portion of government spending on public services or transfers (i.e. welfare) that they consume.

73. The Home Office has built on existing modelling used to assess the fiscal impact from previous changes affecting non-EU migration. We use a static analysis of the 2016/17 fiscal year to estimate tax revenue and government spending attributable to EEA migrants of a given age, economic status and earned income. This analysis is applied to changes in future net EEA migration (by wage, age and economic activity) to estimate the order of magnitude of the impact on the public finances.

74. This analysis is not a projection of the future state of the economy; we use the latest data on fiscal spend and tax rates which captures the UK economy in its current state, adjusting for productivity growth and inflation. This allows us to explore specific impacts of changes to EU migration, holding all other factors constant.

75. In the literature there are a number of different approaches to calculating the effect of policy changes on fiscal balances. The central methodology used here represents a 'marginal' approach to measuring the impact of migration and therefore makes a distinction between spend and revenue that is unlikely to vary according to the number of individuals moving to the UK. We test this assumption within the sensitivity analysis section below.

76. Our modelling framework considers initial impacts of specific policy changes. We do not consider dynamic responses of the economy and behavioural responses of individual and firms. As such, we present fiscal impacts of a change in migration over the short term, defined as the first five years of the policy (2021 to 2025). The approach considers the cumulative change in long-term migrant volumes over this period.

77. We also make no assumption for how migrants age over this period. However, as we are looking over a five-year period, and we estimate spend unit costs in five-year age groups, this should have a relatively small impact.

78. Using this approach, we estimate the modelled long-term skilled route proposals could result in a cumulative net fiscal cost over 5 years (2021 to 2025) of between £2bn to £4bn. This does not capture adjustment of individuals and firms or mitigation of costs through changes to the non-EEA route or any potential increase in temporary workers.

79. The following sections outline in more detail the methodology used for the two components of the analysis, fiscal spend and fiscal revenue.

Fiscal spend

80. The analysis uses a top down approach to apportion total expenditure on public services at the individual level and estimates of unit costs based on public expenditure date, by migrant age group and economic activity. The unit costs are then applied to the estimated change in net EEA migration (by age and economic activity) to estimate the saving in public expenditure.

Key data sources

81. Data on expenditure of public services is obtained from Public Expenditure Statistical Analysis (PESA) published by HM Treasury, which provides data on public sector expenditure broken down by functions. The analysis is based on data for 2016/17[36].

82. Data on migrant population characteristics is obtained from the APS produced by the ONS. APS data for 2016/17 is used to derive population characteristics such as volumes of existing residents by nationality and age distribution. When using estimates of total UK population, the analysis uses ONS 2016[37] data, which is considered more accurate than the APS.

83. Data on social protection expenditure is obtained from the Family Resources Survey[38] (FRS) for 2016/17. FRS data for 2016/17 is used to obtain the average benefit received for EEA nationals of working age in the UK.

[36] https://www.gov.uk/government/statistics/public-expenditure-statistical-analyses-2018

[37] https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration

[38] FRS is self-reported, this means it is likely to under-report benefit receipt figures as some respondents do not know or do not have the necessary information to answer the specific questions about individual benefits which makes it difficult to collate accurate information; more information on this, and the FRS more generally, is available at https://www.gov.uk/government/statistics/family-resources-survey-financial-year-201617. For estimates of benefit expenditure and caseload for EEA nationals, publications from HMRC or DWP should be used; https://www.gov.uk/government/statistics/income-tax-nics-tax-credits-and-child-benefit-statistics-for-eea-nationals-2015-to-2016 and https://www.gov.uk/government/statistics/nationality-at-point-of-national-insurance-number-registration-of-dwp-working-age-benefit-recipients-data-to-november-2017 respectively.

84. Figure 9describes how these data are apportioned on a per capita basis. Unit costs based on 2016/17 analysis are inflated to 2017/18 prices and adjusted using OBR long-term projections real labour productivity growth to account for future economic growth[39].

Figure 9: Methodology for apportioning fiscal spend components across different nationalities

Major spend components	Marginal approach
Public goods (i.e. R&D, Defence) **Debt interest**	Under a marginal approach we only allocate this spend to the resident population. The rationale is that the marginal costs of providing these services to an additional migrant is zero/negligible.
Housing development	Allocated on a per capita basis
Police services	Allocated on a per capita basis
Health	We apply OBR estimates from the Office of Budget Responsibility (OBR) [40] on health spending by age.
Pre-primary education	Allocated evenly to 0-4 year-olds
Primary and secondary education	Allocated evenly to 5-17 year-olds
Tertiary education	Allocated evenly to all those studying for a tertiary qualification (excluding international non-EEA students)
Social protection: benefits	Estimates per head costs based on FRS data to reflect the average benefit received for EEA nationals of working age, dependent on earnings.
Social protection: personal social services	Social protection and social exclusion allocated on a per capita basis. Family and child social services allocated using APS data on EEA share of family units and age of head of household. Old age social services apportioned equally to 65+ population.

Fiscal revenue

85. We use a bottom up approach to calculate the expected contribution to direct and indirect taxes from EEA migrants, based on individuals' characteristics, and data on their earnings and spending patterns. The results are applied to the volume of EEA migrants affected and the expected change in their earnings under migration

[39] https://obr.uk/efo/economic-fiscal-outlook-march-2018/

[40] http://budgetresponsibility.org.uk/fsr/fiscal-sustainability-analytical-papers-july-2016/

policies. This allows us to calculate the total tax revenue forgone due to fewer migrants moving to the UK.

Key data sources

86. Total revenue is taken from the OBR's Economic and Fiscal Outlook[41]. The analysis also considers information on indirect taxes by nationality in the Living Cost and Food survey data between 2014/15 and 2015/16[42] and council tax in ONS data on the effects of taxes and benefits on household income[43] 2016/17.

87. Output from our EU migration model estimates the baseline earnings of EEA migrants and the change under a given policy. Earning are adjusted for real wage growth[44].

Figure 10: Methodology for apportioning fiscal revenue components across different nationalities

Major revenue components	Marginal approach
Income Tax	Tax rates for 2016/17 are applied to estimated taxable income (based on ASHE data) of future EEA migrants
National insurance contributions (NICs)	NICs rates for 2016/17 are applied to estimated earnings of future EEA migrants
Indirect taxes (include VAT, duties on specific products such as alcohol and tobacco, licences such as television and intermediate taxes)	Indirect tax rates are calculated depending on earning deciles. Data from the Living Cost and Food survey[45] between 14/15 and 15/16 is used to estimate the effective tax rate (indirect tax divided by disposable income) by household income decile for EEA nationals. This captures spending patterns (savings/remittances) of EEA nationals.

[41] http://obr.uk/efo/economic-fiscal-outlook-march-2018/

[42] https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/expenditure/adhocs/008529householdexpenditureanddisposableincomebydisposableincomedecilegroupbyoriginofhouseholdreferencepersonukfinancialyearending2015tofinancialyearending2017

[43] https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/incomeandwealth/datasets/theeffectsoftaxesandbenefitsonhouseholdincomefinancialyearending2014

[44] https://obr.uk/efo/economic-fiscal-outlook-march-2018/

[45] https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/expenditure/adhocs/008529householdexpenditureanddisposableincomebydisposableincomedecilegroupbyoriginofhouseholdreferencepersonukfinancialyearending2015tofinancialyearending2017

Company taxes **Business rates**	Businesses are assumed to pass the costs of these taxes onto consumers. Therefore, contributions to Company tax and Business rates are ultimately driven by consumption in the same way as indirect taxes, and the per capita allocation is based on an individual's contribution to indirect taxes.
Council tax	Allocated depending on earning deciles, based ONS[46] estimates of council tax paid per household in each income decile. An adjustment is made for those receiving a council tax reduction and the number of economically active individuals in each household.
Capital gains tax **Inheritance tax** **Gross operating surplus, interest and dividends** **All other taxes/income streams**	Under a marginal approach this revenue is allocated only to the resident population. The rationale is that a newly arrived migrant will have little or no impact on these revenue streams.

[46] https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/incomeandwealth/datasets/theeffectsoftaxesandbenefitsonhouseholdincomefinancialyearending2014

Labour market adjustment

Approach and rationale

88. The analysis in previous chapters makes no assumption for the potential behavioural responses of employers and market adjustment. However, the labour market is dynamic and, as with any change in environment, we would expect markets to adjust and reallocate resources to their most productive use. How employers choose to adjust and the relative ease with which this can be done will depend on the specific characteristics of an occupation (in particular whether it is governed predominately by market forces) as well as wider economic factors.

89. To complement the modelling of initial impacts on the labour market, we have developed bespoke analysis to assess which occupations might be more or less likely to adjust to changes in labour supply and provide further context as to the relative importance of impacts on the labour market. We do this by creating a set of three indicators based on published data. The first considers the potential scope for adjustment. This is combined with two further indicators looking at the relative value (either economic or social value) and the reliance on EEA workers, to assess which occupations may face most difficulties, and where there may be some need to consider the impact of policy proposals carefully.

Potential scope for adjustment

90. This measure aims to capture the ability of occupations to adjust to unexpected changes in labour supply, either by substituting labour for labour or capital for labour.

91. Occupations within sectors responsible for the provision of public services, such as medical services, education, social services, public administration and care are automatically assessed as occupations that might struggle to adjust by raising wages in order to substitute labour for labour. This is because wages within such sectors are driven primarily by government policy, and so they are unlikely to adjust automatically to market forces and any change would have implications for public finances.

92. Occupations that are governed by market forces might be able to more easily adapt to labour supply changes. However, certain factors may mean that they are not able to do so. We use the following indicators to assess these occupations' scope for adjustment:

- *Scope for automation* – We assume this indicator acts as a proxy for the ability of labour to be substituted for capital within an occupation, since automation is

the most transparent form of capital substitution. This is based on research conducted by Frey and Osborne (2013)[47]. The share of jobs in each occupation at risk of automation can provide an indication of the probability of automation of roles within an occupation[48]. Occupations with a low probability of automation may find it hard to adjust to labour supply reductions.

- *Real wage growth* – We include real wage growth as an indicator of whether occupations are currently experiencing labour shortages, as an occupation struggling to recruit workers might increase wages to become more attractive to potential workers. A further reduction in labour supply could exacerbate these existing shortages.

- *Underemployment* – In occupations with underemployment, employers might respond to a reduced labour supply by increasing the hours worked by the current workforce employed. If a small proportion of workers within an occupation say they would like to work more hours, this implies that there is minimal underemployment in these occupations.

- *Hard to fill vacancies as a proportion of total employment* – We include hard to fill vacancy rates to establish whether an occupation is experiencing a labour shortage. If hard to fill vacancies form a large proportion of total employment for an occupation, it could indicate that there are structural issues within these occupations which is making it hard for employers to hire workers. These issues could include a poor working culture, a shortage of skilled workers or if the employer is based in a rural occupation[49].

High wage and high contribution to public services

93. This indicator looks at the relative value of occupations affected, either economic or social value. Some areas of the labour market might provide greater economic value to the wider economy, and it is, therefore, important to understand whether labour supply changes are related to occupations that contribute disproportionately to the output of the economy.

94. Equally, some parts of the labour market may contribute less to economic output but provide greater social value in terms of positive non-market spill-overs to the wider economy or are vital to the delivery of key public services.

[47] Carl Benedikt Frey and Michael A. Osborne, 'The Future of Employment: How Susceptible are Jobs to Computerisation?' *Oxford Martin Programme on Technology and Employment* (2013) pp. 1-77

[48] Estimates for the probability of automation consider recent technological advances such as advanced robotics to assess the potential for job automation over some unspecific years, which we interpret as medium to long run.

[49] This builds on the MAC's methodology which uses total vacancies as a proportion of total employment to assess labour shortages. However, this measure does not establish the type of vacancies, such as hard to fill.

Recent reliance on migrant labour

95. The extent to which affected occupations might need to adjust to labour market changes could depend on how reliant they have been on migrant labour. Occupations that have been heavily reliant on EEA migrant labour may have a more pressing need to adjust (for example, by increasing wages).

Data

96. The analysis uses several published data sources, summarised in Figure 11.

Figure 11: Sources of data used for each indicator

Measure	Data source	Year
High wage	ASHE	2017
High contribution to public services	APS	2014-2016 (three-year pooled)
Recent reliance on migrant labour[50]	APS	2012-2016
Potential scope for automation	Frey and Osbourne	2013
Real wage growth (inflation adjusted to 2016/2017)	ASHE	2014-2017
Underemployment	APS	2014-2016 (three-year pooled)
Hard to fill vacancies as a proportion of total employment	Employer Skills Survey (ESS) and APS	2017 ESS and 2014-2016 (three-year pooled APS)

Key assumptions

97. Due to samples size limitations at four-digit standard occupation classification (SOC) level, we analyse occupations within three-digit SOC groupings.

98. Occupational skill level is determined at a four-digit SOC level. Multiple four-digit occupations make up each three-digit SOC grouping. Where there are multiple four-digit occupations with different skill levels we assume the overall skill level for the three-digit SOC is equal to the skill level in which the majority of EEA nationals work.

99. Occupations that recorded small sample sizes at a three-digit level[51] from the APS were excluded from the analysis which measures an occupation's reliance on migrant labour for statistical validity.

[50] Occupations that recorded small sample sizes for migrant employment growth were excluded from this measure; 40 occupations were excluded.

[51] Small sample size being an average unweighted count below 30 observations from 2012 to 2016.

100. We focus on occupations most affected by the policy. Occupations that are classified as most affected are those that are estimated to experience at least a 25% reduction in EU long-term worker inflows.

Key limitations

101. Scope for adjustment is measured based on four criteria to assess the ability of occupations to substitute labour for labour or capital for labour. This indicator can provide an indication of occupations potentially facing challenges based on our chosen criteria. However, this does not capture all the ways employers may adjust to policy changes.

102. The final selection of occupations is based on several key judgements around thresholds. For example, occupations need to be in the top 25% for more than one of the 'hard to adjust' criteria in order to be judged as potentially facing adjustment difficulties. There is a risk that vulnerable occupations which fall below this margin are excluded.

103. This analysis also relies on the assumption that outcomes observed in the past are representative of future trends, but in practice the dynamic nature of the labour market might mean that this is not the case. For example, expectation and the ability of occupations to adjust following a labour supply change will also depend on the wider economic environment, such as changes in trade.

Methodology

104. Using the indicators described above, we are able group occupations into broad categories.

High wage and high contribution to public services

105. There are two sub-components to this measure:

- *High wage* – Occupations are ranked based on their average wage, and those occupations in the top quartile of the rankings are indicated as areas of the labour market that might be of high relative importance to the wider economy.

- *High contribution to public services* – We also consider occupations which contribute highly to the delivery of public services, based on their EEA workforce share in the following sectors: social work, care, public administration, education and medical services. Occupations can work across a number of different sectors, in order to consider the main occupations specific to these sectors we consider the share of EEA workers in each occupation within these five sectors.

Occupations in the top decile of this ranking are included as occupations that have a high contribution to public services.

Recent reliance on EEA workers

106. This indicator considers annual average employment growth in each occupation between 2012 and 2016. We look at three sub-components:

- *Absolute EEA employment growth* – We assess occupations with the highest absolute employment growth.

- *EEA employment growth in growing occupations* – We consider occupations where a high proportion of total employment growth was driven by growth in EEA nationals.

- *EEA employment growth in shrinking occupations* – We also consider occupations which saw growth in EEA employment, whilst shrinking overall (either due to declining employment for non-EEA and/or UK nationals).

107. Occupations are ranked for each of the sub-components above. Those occupations in the top quartile of rankings for at least one sub-component are defined as 'high reliance' occupations.

Potential scope for adjustment

108. This measure assesses occupations against four sub-components. A high ranking indicates occupations may face difficulties under a specific indicator:

- *Scope for automation* – Occupations are ranked according to their probability of automation. Those with a low probability of automation rank highly.

- *Real wage growth* –The analysis ranks occupations based on their real wage growth, adjusting wages to account for inflation[52]. Occupations with positive real wage growth rank highly.

- *Underemployment* – The analysis ranks occupations based on the proportion of employees that would be willing to work longer hours. Occupations with minimal underemployment rank highly.

- *Hard to fill vacancies as a proportion of total employment* – The analysis ranks occupations based on hard to fill vacancy rates. Occupations with a large hard to fill vacancy rate rank highly.

[52] Inflation is adjusted to calendar year 2016/17.

109. When making a final judgement on the likelihood of occupations facing adjustment difficulties, the analysis ranks occupations for each sub-component. Occupations that are ranked in the top quartile for at least two of the sub-component are indicated as occupations that are likely to face adjustment difficulties.

110. Occupations within sectors responsible for the provision of public services, such as medical services, education, social services, public admin and care are automatically included within this indicator.

Results

111. **High wage:** Our analysis suggests that there are 12 skilled occupations and three lower skilled occupations, which are highly affected by the policy, and which might be of economic importance – this is measured by an average wage of at least £32,000.

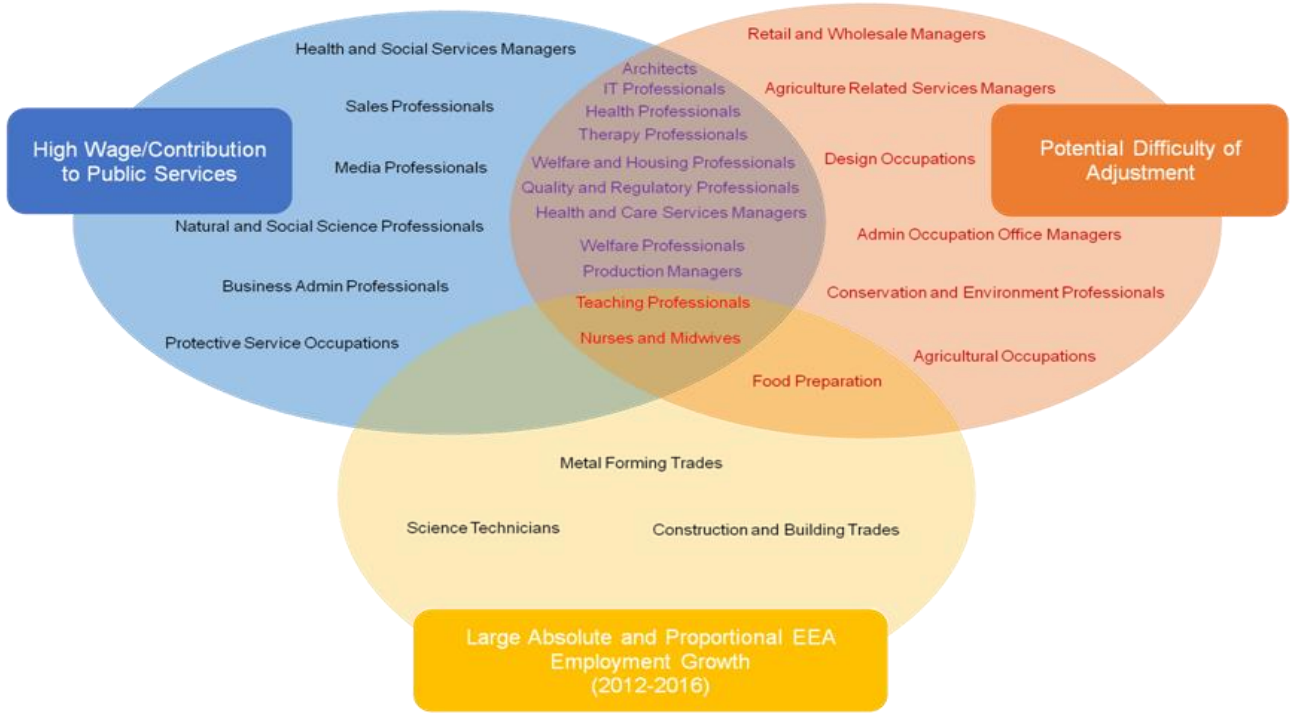
112. **High contribution to public services:** The analysis indicates that there are seven skilled and two lower skilled occupations which are highly affected, and which contribute extensively to the delivery of key Government services. These occupations are predominately in Health, Education and Welfare. For these chosen occupations, at least 76% of the EEA workforce are employed in sectors that deliver public services.

113. **Recent reliance on EEA migrant labour:** There are six skilled and 15 lower skilled occupations that are classified as high reliance occupations. Those that rank highly for absolute EEA employment growth had growth of at least 4,400 EEA workers across 2012 to 2016, and 2,300 in shrinking occupations for the same period. Likewise, absolute EEA employment growth across 2012 to 2016 accounted for at least 76% of total employment growth in occupations selected based on their proportional EEA employment growth.

114. **Potential scope for adjustment:** The analysis suggests that 18 skilled and nine lower skilled occupations are highly affected by the modelled policy and could face adjustment difficulties. Those occupations that ranked in the top quartile for scope of automation had a probability of automation below 17%. Similarly, for occupations highly ranked based on underemployment, fewer than 5% of employees indicated that they would work longer hours. Hard to fill vacancy rates were at least 1% for occupations in the top quartile of this measure. Moreover, occupations highly ranked for real wage growth experienced at least 4% growth from 2014 to 2017. The occupations that the analysis indicates as important to public services are also assumed to potentially face labour marker adjustment difficulties.

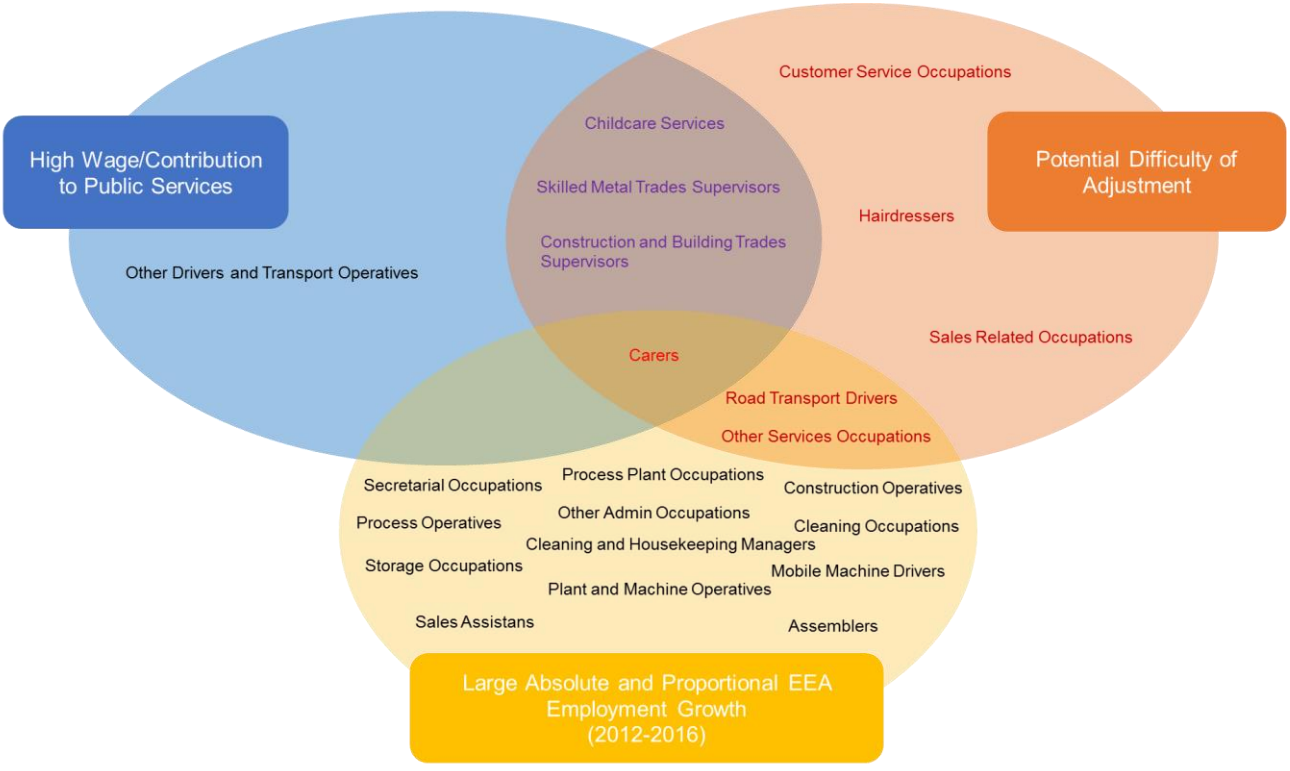
115. A summary of the findings can be found in Figure 12 and Figure 13 below.

Figure 12: Skilled occupations facing labour market adjustment difficulties and of high relative value



Skilled occupations illustrated rank highly for the relevant criteria

Figure 13: Low skilled occupations facing labour market adjustment difficulties and of high relative value



Low er skilled occupations illustrated rank highly for the relevant criteria

Occupations that could increase wages to continue to hire migrant workers

116. We build on this analysis to understand better the potential scope for employers to increase wages in order to continue to hire migrant labour. The analysis below focuses on medium-skilled occupations, where the majority of workers currently earn above £25,000.

117. We identify 16 medium-skilled occupations where the majority of workers earn over £25,000[53]. Workers in these occupations are estimated to account for around 20% of the total labour force, and migrants account for 7% of the total workforce in these occupations.

118. We have used three indicators described above to identify whether employers in these 16 occupations may be more or less likely to adjust their behaviour to increase wages. These indicators are:

- Real wage growth – The analysis selects occupations that have experienced real wage growth between 2014 and 2017 as those which may be able to adjust wages upwards to attract more workers. Although rising real wages can be an indication of existing shortages, it also shows that employers in those occupations are able to respond to this and may continue to do so following further labour supply changes. Our analysis suggests that nine (of the 16) occupations[54] have experienced positive wage growth between 2014 and 2017 (see Figure 14), and this suggests that employers may be willing to adjust wages upwards to the £30,000 threshold so they can continue to hire migrant workers.

- Reliance on migrant workers – Unlike in the first part of the analysis, this section looks at occupations change in reliance on migrant workers, rather than just EEA workers. This is because if employers are able to increase wages to meet the proposed salary thresholds they will be able to hire EEA and non-EEA labour. An increasing reliance on migrant workers indicates where there is current demand for migrant workers, and these occupations may be more likely to adjust in order to continue to hire migrant workers in the future. The analysis examines the change in reliance on migrant labour from 2012 to 2016. Almost

[53] There are, in fact, 21 medium-skilled occupations with an average salary above £25,000, but five of these have been excluded from this analysis due to small sample sizes. This does not have an impact on the results as these occupations, by definition, only account for a small proportion of the workforce.

[54] Occupations that have experienced positive wage growth are managers and directors in retail and wholesale, IT technicians, protective service occupations, sales, marketing and related associate professionals, administrative occupations, metal machining, fitting and instrument making trades, vehicle trades, electrical and electronic trades and customer service managers.

all occupations with an average salary above £25,000 have seen an average proportional growth of non-EEA workers, which also suggests that employers may be willing to adjust their behaviour to hire migrants[55].

- Hard to fill vacancy rate – The analysis assesses the ratio of hard to fill vacancies relative to total employment. Occupations which have a lower than average[56] hard to fill vacancy rate are assessed as areas of the labour market which might not have structural issues when attempting to recruit workers, enabling them to adjust to changing labour market dynamics. The proportion of hard to fill vacancies relative to total employment is below the average[57] for 12 occupations[58], which suggests that structural problems may be smaller in these occupations, and this may allow migrants to fill these vacancies.

119. A summary of results can be seen in Figure 14.

[55] All the occupations except for vehicle trades have been heavily reliant on migrants in recent years.

[56] Average proportion of hard to fill vacancies relative to total employment for all occupations with a skill level between RQF 3 and RQF 5.

[57] The average proportion of hard to fill vacancies relative to total employment for all occupations with a skill level between RQF 3 and RQF 5 is 1%.

[58] Occupations that have a below average proportion of hard to fill vacancies relative to total employment are managers and directors in retail and wholesale, managers and proprietors in other services, science, engineering and production technicians, protective service occupations, artistic, literacy and media occupations, design occupations, sales, marketing and related associate professionals, public services and other professionals, administrative occupations, electrical and electronic trades, construction and building trades and customer service managers.

Figure 14: Medium-skilled occupations most able to raise wages to meet the £30,000 threshold[59]

Occupation	% of workers earning £25,000+	Recent wage growth	% of total labour force	Migrant employment share growth	Hard to fill vacancy rate
354 - Sales, Marketing and Related Associate Professionals	54%	YES	3.0%	29%	1%
531 - Construction and Building Trades	58%	NO	2.7%	77%	1%
125 - Managers and Proprietors in Other Services	52%	NO	1.9%	57%	0%
356 - Public Services and Other Associate Professionals	65%	NO	1.7%	44%	1%
524 - Electrical and Electronic Trades	57%	YES	1.4%	16%	1%
341 - Artistic, Literary and Media Occupations	57%	NO	1.3%	6%	0%
331 - Protective Service Occupations	76%	YES	1.2%	100%	1%
119 - Managers and Directors in Retail and Wholesale	75%	YES	1.1%	100%	1%
522 - Metal Machining, Fitting and Instrument Making Trades	59%	YES	1.0%	52%	3%
311 - Science, Engineering and Production Technicians	65%	NO	0.9%	100%	1%
523 - Vehicle Trades	64%	YES	0.9%	-2%	3%
416 - Administrative Occupations: Office Managers and Supervisors	58%	YES	0.7%	13%	0%
313 - Information Technology Technicians	63%	YES	0.6%	100%	2%
342 - Design Occupations	86%	NO	0.5%	19%	1%
722 - Customer Service Managers and Supervisors	53%	YES	0.4%	51%	0%
521 - Metal Forming, Welding and Related Trades	58%	NO	0.3%	266%	2%

[59] Shaded cells identify occupations more likely to be able to adjust. Occupations are listed in order of workforce size.

ISBN:978-1-78655-764-3

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