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Abstract

We assess the impact of the UK leaving the European Union (EU) on benefit and tax credit receipts of low income households using detailed fiscal and population data. First, we quantify the effect of leaving the EU on the UK fiscal position from two major sources: (i) the impact on national income and (ii) possible changes in migration. We also account for changes in net contributions to the EU budget. We use a range of possible national income and migration scenarios as inputs for our model estimates. Based on this range of inputs, we estimate that the fiscal deficit will be 0.78%-6.14% of real GDP larger in 2020 than in the baseline case of remaining in the EU. The corresponding figures for 2030 are 1.03%-7.12%. Second, we calculate the average annual tax credit and benefit receipts of low income households. We find that tax credit and benefit payments comprise at least between 29% and 73% of a low income household's average annual income. Third, we assess how the projected fiscal changes due to leaving the EU might affect the benefit and tax credit receipts of low income households. We find that our central estimate of the fiscal shortfall due to leaving the EU is 41% of the projected baseline welfare budget in 2020 and 45% in 2030. We assume that the government decides to meet the fiscal targets set out in its Fiscal Charter. In order to recover its fiscal position the government will have to alter its tax and spending policies. In the worst case, where the government places 100% of the burden of adjustment on welfare spending, we calculate that different categories of low income households could receive between £1,861 and £5,542 per year (in 2014 £) less in tax credit and benefit payments in 2020 and between £2,076 and £6,184 per year (in 2014 £) less in welfare payments in 2030.

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Summary of Headline Results

• The Fiscal Impact of Brexit

- When accounting for both the national income and net migration impacts of Brexit, we estimate that the UK fiscal deficit will be 0.78%-6.14% of real GDP larger in 2020 than in the baseline case of remaining in the EU. The corresponding figures for 2030 are 1.03%-7.12% of GDP.

• Tax Credit and Benefit Receipts of Low Income Households

- For the purpose of this study, we define a low income household as a household in receipt of tax credits or jobseeker's allowance. The below table summarises the estimated average annual tax credit and benefit receipts of different types of low income households in 2014 pounds, as well as the percentage of total annual gross household income.

Table: Average Annual Tax Credit and Benefit Receipts of Low Income Households (2014 £) and Percentage of Annual Gross Total Household Income

	Single, Working Age, No Children	Single, Disabled, No Children	Couple, Working Age, No Children	Couple, Working Age, 1 Child	Couple, Working Age, 2 Children	Lone Parent, Working Age, 1 Child	Lone Parent, Working Age, 2 Children	Single, Unemployed, No Children
Total	£5,913.49	£10,805.77	£4,585.21	£9,078.23	£11,937.36	£11,292.19	£13,657.91	£5,499.63
% Income	34.16%	55.56%	28.72%	41.87%	45.62%	50.38%	56.27%	72.96%

• The Impact of Brexit on Tax Credit and Benefit Receipts of Low Income Households

- We assume that the government decides to meet the fiscal targets set out in its Fiscal Charter. In order to recover its fiscal position the government will have to alter its tax and spending policies. We assess the impact of possible changes due to Brexit on the tax credit and benefit receipts of low income households.
- We find, using our central estimate, that the fiscal shortfall due to Brexit – when accounting for both the national income and net migration impacts of Brexit – constitutes 41% of the projected welfare budget in the 2020 in the baseline scenario. The corresponding value for 2030 is 45%. The below table presents the estimated loss in the average annual tax credit and benefit receipts of low income households due to the fiscal impact of Brexit, using our central estimate of the fiscal shortfall, if the welfare budget bears 25%, 50%, 75% and 100% of the burden of adjustment due to the total fiscal shortfall.

Table: Estimated Loss in Annual Tax Credit and Benefit Receipts of Low Income Households (2014 £) Due to the Fiscal Impact of Brexit if the Welfare Budget is Cut, Bearing x% of the Fiscal Adjustment in 2020

Burden: Welfare Budget x%	Single, Working Age, No Children	Single, Disabled, No Children	Couple, Working Age, No Children	Couple, Working Age, 1 Child	Couple, Working Age, 2 Children	Lone Parent, Working Age, 1 Child	Lone Parent, Working Age, 2 Children	Single, Unemployed, No Children
25%	£600	£1,096	£465	£921	£1,211	£1,146	£1,386	£558
50%	£1,200	£2,192	£930	£1,842	£2,422	£2,291	£2,771	£1,116
75%	£1,800	£3,289	£1,396	£2,763	£3,633	£3,437	£4,157	£1,674
100%	£2,400	£4,385	£1,861	£3,684	£4,844	£4,582	£5,542	£2,232

1. Introduction

The UK referendum on its EU membership is likely to alter the course of British and European history. While this is fundamentally a political choice, the economic consequences are, quite reasonably, central to the debate. There are several economic assessments about the impact of the UK leaving the European Union (EU), commonly referred to as 'Brexit'. One issue which, to the best of our knowledge, has been omitted from the macroeconomic and sector-oriented assessments to date is the possible affect of Brexit on the welfare support for low income households.¹ This is obviously particularly important given that low income households are often the most vulnerable in society.

In this paper, we address this omission and quantify a stylised impact of Brexit on low income households due to fiscal changes. The analysis is carried out in three stages. First, we use detailed data relating to specific items of fiscal spending and revenue, as well as population projections by age and gender. We then assess the impact of Brexit on UK fiscal outcomes from two major channels: (i) the impact on national income due to Brexit and (ii) expected changes in migration due to Brexit. We also account for changes in net contributions to the EU. From this, we attain estimates of the fiscal gap – the change in the UK fiscal deficit due to Brexit. Second, we use household survey data to impute the average annual benefit and tax credit receipts of households. For the purpose of this study, we define a low income household as a household in receipt of tax credit or Jobseeker's allowance. We find that tax credits and benefit receipts comprise a substantial fraction of low income households' annual income. Third, we assess the impact of Brexit on low income households' average annual tax credit and benefit receipts. Because the projected fiscal gap due to Brexit is sizable, it is likely that welfare spending will have to be reduced to recover the shortfall. Using the average annual benefit and tax credit receipts we calculate, we estimate the likely effects of changes in the welfare budget on different types of low income households. We present a number of scenarios to reflect the uncertainty of the consequences and policies that would follow Brexit.

To estimate the fiscal effect of Brexit, we use data from a range of sources. First, we construct a dataset of UK public sector revenue and spending items using data from the Office of Budget Responsibility (OBR) and the Department for Work and Pensions (DWP), which include projections out to 2020. Second, we use population projections, by age and gender, produced by the Office for National Statistics (ONS). Third, to combine these, and infer tax and transfer payments by age and gender, we use gender-specific age profiles for these items. That is, we are able to assess how tax and transfer payments differ across genders and age groups. We view this as a significant advantage of our approach, as it allows us to assess both the macroeconomic effect of Brexit due to the impact on national income, as well as the possible fiscal effects of Brexit from changes in the population composition emanating from different migration policies.

We construct a 'baseline' scenario for fiscal items in which Brexit does not occur. Our baseline projection runs to 2030, allowing us to consider the effects of Brexit over a 14 year horizon. The baseline projection draws heavily on the fiscal projections of the OBR out to 2020, so accounts for

¹ There are of course many other issues and uncertainties around this debate (including possible trade agreements, UK constitutional issues) that are not the focus of this study. For assessments of other macroeconomic effects associated with leaving the EU see Ebell and Warren (2016) and Lisenkova and Sanchez-Martinez (2016).

planned policy changes until then. Our projections from 2021 to 2030 rely on specific assumptions about the future evolution of the UK economy. However, as the focus of our analysis is the ‘fiscal gap’ due to Brexit – i.e. by how the fiscal deficit will change in the event of Brexit relative to the baseline – these assumptions are not of first-order importance for our results.

To assess the impact of Brexit on the UK’s fiscal position, we construct scenarios using widely quoted macroeconomic estimates of the effect of Brexit and estimate the impact on the UK fiscal accounts. In these scenarios we consider the effects of both the change in GDP and changes in migration. We also account for changes in net contributions to the EU. We are able to consider the latter because of our detailed data relating to the distribution of fiscal revenue and spending by age and gender. Our method for estimating the impact of Brexit on the fiscal accounts is similar to that of the OBR. We account for the elasticity of fiscal items with respect to a GDP shock, drawing on Helgadottir, Chamberlin, Dhimi, Farrington and Robins (2012). A comparison of our Brexit scenarios with the baseline provides us with estimates of the fiscal gap in the event of Brexit. We predict that, by 2020, the fiscal deficit will be between 0.78% and 6.14% of GDP larger than in the baseline scenario. The corresponding figures for 2030 are 1.03%-7.12%.

To assess the impact of fiscal policy changes on low income households due to changes in benefit and tax credit payments, we first calculate the average annual tax credit and benefit receipts of these households. We define a low income household as a household in receipt of tax credits or Jobseeker’s allowance. We use Labour Force Survey (ONS, 2014) and Department of Work and Pension (DWP, 2015) data for this. We consider eight types of low income households: single working age adults with no children; single working age disabled adults with no children; couples of working age with no children; couples of working age with 1 child; couples of working age with 2 children; a lone parent of working age with 1 child; a lone parent of working age with 2 children; and a single working age adult with no children and receiving Jobseeker’s allowance. We find that tax credit and benefit receipts comprise between 29% and 73% of the total income of different categories of low income households.

To calculate the impact of Brexit on the tax credit and benefit receipts of low income households, we assume that the government seeks to recover the fiscal shortfall due to Brexit. This accords with the current UK Fiscal Charter – delivering a surplus in 2019-20 and remaining in surplus thereafter in ‘normal times’.² This is unlikely to constitute ‘normal times’, but the Chancellor will be required to deliver a plan to return the budget back into surplus. Assuming the charter remains in place and certain areas of government spending continue to be protected, it is likely that welfare spending must fall as part of the policy mix to fill the fiscal shortfall due to Brexit. We consider various combinations of welfare cuts, in particular: when 25%, 50%, 75% and 100% of the burden of adjustment falls on welfare spending. We assume that all welfare spending items will fall equi-proportionally, and thus estimate the reductions in average annual tax credit and benefit payments to low income households. We find that, in a scenario where welfare spending bears 100% of the burden of adjustment from our central estimate of the fiscal shortfall due to Brexit, low income

² The fiscal targets apply unless the OBR assess that there has been a significant negative shock to the economy. There is a significant negative shock if real GDP growth is less than 1% on a rolling 4 quarter-on-4 quarter basis. If this occurs the fiscal target for a surplus each year is suspended and the Treasury must then set out a plan to return the budget to surplus including temporary fiscal targets.

households stand to lose between £1,861 and £5,542 a year in 2020 (in 2014 pounds) due to benefit and tax credit cuts alone. This represents a sizeable portion of income for low income households.

This work relates to a growing literature on the effects of Brexit on the UK economy, which highlights a range of factors through which Brexit may affect macroeconomic outcomes in the UK. Our methodological design allows us to account for many of these factors in our fiscal projections, for instance: international trade, migration, investment, and net contributions to the EU budget. Much of the existing literature concentrates on the consequences of Brexit for national income and the national budget (HM Treasury, 2016a; Dhingra, Ottaviano, Sampson, and Van Reenen, 2016a, 2016b; OECD, 2016; Baker, Carreras, Ebell, Hurst, Kirby, Meaning, Piggott and Warren, 2016; and Ebell and Warren, 2016). Our headline figure is comparable in scale to Dhingra et al. (2016b) who calculate that, in the short run, UK incomes could be between £850 and £1,700 per household lower due to the trade and income effects of Brexit. Our estimate provides an estimate of the losses for low income households *in addition* to those of Dhingra et al. (2016b) and others. Some of the related literature focuses on the potentially beneficial effects of Brexit, such as a lower net contribution to the EU budget which may ease the national budget constraint.

To the best of our knowledge, there is just one existing study into the effect of Brexit on the UK's public finances (IFS, 2016). IFS (2016) estimate that Brexit could result in a £40bn fiscal shortfall in 2019/20 if GDP was 3.5% lower in 2030. Our methodology extends upon IFS (2016) by accounting for disaggregated effects of Brexit on different fiscal items and the effects of migration changes on the fiscal balance sheet. Despite differences in methodology, our results are strikingly similar: we estimate that Brexit will result in a £44bn fiscal shortfall in 2020.

The rest of the paper is structured as follows. In section 2, we introduce the dataset underlying our fiscal projections. Section 3 presents the scenarios we consider in our fiscal projection. Section 4 provides a technical description of our fiscal projections; the non-technical reader can skip over this section. In section 5, we outline our estimates of the impact of Brexit on the UK fiscal position. In section 6, we calculate the average annual tax credit and benefit receipts of low income families and estimate the impact of Brexit-induced fiscal changes on these figures. Section 7 concludes.

2. Data for Estimating the Fiscal Gap Due to Brexit

We use three types of data in our analysis: realised and projected UK population by age and gender; realised and projected UK public sector revenues and spending; and age and gender profiles for tax and transfer payments. The base year for the analysis is 2014.

We use 2014-based principal population projections produced by the ONS (2015). These provide projections for the UK population by gender and age out to 2114.

Table 1 provides a list of the UK public sector revenue and spending items included in the analysis. We use data from the *Economic and Fiscal Outlook* (OBR, 2016) for all revenue items. We use data from the DWP (2016) for benefit spending. Data on health and education spending are from the *Fiscal Sustainability Report* (OBR, 2015). For all series, our dataset includes realised outcomes for 2014 and projections from 2015 to 2020. The raw data are nominal. To deflate the data, we use forecasts of the annual rate of GDP deflator inflation from OBR (2016). The resulting series are in constant prices, with 2014 base year.

Table 1: List of Fiscal Items Included in the Dataset

Revenues	Benefits/Services
Aggregates levy	Attendance allowances
Air Passenger Duty	Bereavement allowance
Alcohol	Carer's allowance
Betting, gaming and lottery	Child benefit
Capital Gains Tax	Debt Interest ¹
Climate Change Levy ¹	Defence ¹
Corporation Tax: Financial	Disability living allowances
Corporation Tax: Non-Financial	Discretionary housing payments
Council Tax	Education
<i>EU ETS Auction Receipts¹</i>	Employment and support allowance
Fuel Duty	Health
Gross Operating Surplus ¹	Housing benefit
Income Tax	Housing and Environment
Inheritance tax	Incapacity benefits
Insurance premium tax	Income support-Unretired
Interest and Dividends ¹	Industrial injury benefit
Landfill tax	Industry, Agriculture and Employment
NI contributions	Jobseeker's allowance
Non-domestic rates (aka, business rates)	Maternity Benefits
Other taxes and royalties	<i>Net contribution to EU budget¹</i>
Other taxes on income and wealth	NI pension projections: basic pensions ²
Rent and other current transfers	Other expenditure ¹
Stamp duties	Over 75 TV licence
Tobacco	Pension Credit
VAT	Tax Credit
Vehicle Excise duty	Public Order
	Severe disablement allowance
	Statutory maternity pay
	Transport
	Winter fuel payments

Note: List of fiscal items included in dataset. EU-related fiscal items are italicised for ease of reading.

¹Denotes fiscal items which we project at an aggregate level from 2021 onwards, rather than at the group level. ²Denotes a fiscal item which we project in a unique manner from 2021 onwards to account for announced changes in the state pension age.

Given the question at hand, we take special account of EU-related fiscal items in our dataset (italicised in table 1). On the revenue-side of the fiscal balance sheet, we explicitly account for EU Emissions Trading Scheme (ETS) Auction Receipts. We account for *net* public sector contributions to the EU budget on the spending-side of the balance sheet. These net contributions consist of gross contributions to the EU Budget, a rebate from the EU, and UK public sector receipts from the EU.³ Table 2, from HM Treasury (HMT, 2015), outlines the constituents of net EU contributions for the calendar years 2009 to 2014. The gross payments include Traditional Own Resource (TOR) payments

³ Payments to the EU are used to fund the EU spending budget, of which Common Agricultural Policy (CAP) expenditure comprised 39% in 2013.

by the UK public sector to the EU; these consist of customs duties and sugar levies.⁴ UK public sector receipts from the EU are formed mainly from the European Agricultural Guarantee (EAGF), European Agricultural Fund for Rural Development (EAFRD) and the Social and Regional Development Funds.⁵ The majority of these receipts are either paid to, or used in support of, the private sector, but are channelled through government departments or agencies. The EU also makes some payments directly to the private sector – for research activities, for example – which are not included in table 2 or our dataset.⁶

Table 2: Gross payments, rebate and receipts to EU (by calendar years)

(£ million)	2009 Outturn	2010 Outturn	2011 Outturn	2012 Outturn	2013 Outturn	2014 Outturn
Gross Payments	14129	15197	15357	15746	18135	18777
Less: UK rebate	-5392	-3047	-3143	-3110	-3674	-4416
Less: Public sector receipts	-4401	-4768	-4132	-4169	-3996	-4576
Net contributions to EU Budget	4336	7382	8082	8467	10465	9785

Source: HM Treasury (2015), Table 3.A.

To infer tax and transfer payments by age and gender, we use age profiles by gender for taxes and transfers (see Lisenkova, Sanchez-Martinez and Sefton, 2015, and Lisenkova and Sanchez-Martinez, 2016, for more details). These profiles show the age distribution of a specific tax or transfer that an average person of a certain gender pays or receives over their lifetime. The sum of the monetary values paid or received at each age is normalised to one. For benefit profiles, we use administrative data from the DWP wherever possible.⁷ We assume that all EU-related fiscal items have a ‘flat’ profile. That is, they affect all individuals equally, regardless of age or gender.

To accurately assess the age dimension of tax incidence, we assume that taxes are borne by the generations that actually pay them and that they are accounted for in the same period in which they are paid. For transfers, the rule is to assume that those who receive the transfer coincide with those who benefit from it.⁸

⁴ OBR (2016) reports TOR contributions to the EU on both the revenue and spending-sides of the UK public sector budget. We solely attribute these to the spending-side of the balance sheet, in accordance with the National Accounts, deeming them to be collected on behalf of the EU.

⁵ The EAGF finances direct payments to farmers under the Common Agricultural Policy (CAP) and measures to regulate agricultural markets such as intervention and export refunds. EAFRD was established in 2005, and aims at strengthening the EU’s rural development policy.

⁶ The European Commission does publish outturn data on all member states’ contributions to the EU budget and their receipts in previous years, which include private sector payments. However, these data are released retrospectively and no projection for private sector payments is available. Between 2010 and 2013, total private sector receipts from the EU were between £0.6 billion and £1.8 billion.

⁷ This is the case for a large number of benefits, where weekly average payments by age and gender can be retrieved from the DWP’s tabulation tool: <http://tabulation-tool.dwp.gov.uk/100pc/>.

⁸ Child benefit is an exception to this. Even though the claimants are parents and hence the actual cash is received by them, we assume that this benefit accrued to children below the age of 16.

3. Scenarios for Estimating the Fiscal Gap Due to Brexit

We investigate the effects of Brexit up to 2030. We consider two economic effects of Brexit – due to economic growth and changes in migration – jointly and separately, allowing us to decompose the effects of the two. We also account for lower net contributions to the EU. We compare these outcomes to a ‘baseline’ scenario, in which the UK remains in the EU. In our Brexit scenarios, we assume that the first effects occur in 2017.

Baseline Scenario

Because of data availability and the expected timing of any exit from the EU, we account for three periods in our baseline scenario. Between 2014 and 2016, our data includes outturns and projections for all fiscal items listed in table 1. Because of the Brexit timing, we merely calculate the distribution of fiscal items by age and gender for the 2014-16 period in both the baseline and Brexit scenarios. Between 2017 and 2020, our data includes projections for fiscal items from the OBR and DWP. Because these projections account for planned policy changes, we take these as given in our baseline scenario, and thus calculate the distribution of fiscal items by age and gender.

From 2021 onwards, projections for fiscal items are not available. Thus, we calculate *both* projections for fiscal items at an aggregate level *and* the distribution of fiscal items by age and gender in the baseline case. In our baseline projection, we assume that most fiscal items grow at a rate of 2% per annum in per capita terms from 2021 onwards.⁹ By projecting items forward using a per capita growth factor – instead of an aggregate growth factor – we are able to separately account for changes in macroeconomic aggregates and changes in the population composition in our Brexit scenarios.¹⁰ That is, we can separately identify the fiscal effects of Brexit due to losses in national income and changes in migration.

For all years in our baseline scenario, we use the 2014-principle population projection (ONS, 2015) to capture the evolution in the population composition.

Brexit Scenarios

Because of our detailed dataset, we separately account for two effects of Brexit on the UK’s fiscal position: (i) the impact on national income and (ii) changes in migration. We also account for changes in net contributions to the EU budget. Each of these factors will exert distinct effects on the fiscal position in the UK, as well as a joint effect. We investigate both a decomposition of their individual effects and the joint effect of the two.

Macroeconomic Impact: We turn now to a discussion of the macroeconomic impact of leaving the EU. Table 3 presents a summary of headline estimates of the macroeconomic costs of Brexit.

The OECD’s analysis (OECD, 2016) accounts for a number of factors in its estimates, including the impact on migration flows as well as some potential benefits from deregulation – although these are quantitatively small. OECD (2016) conclude that the key mechanism leading to the decline in real

⁹ This growth rate corresponds to the long-run growth rate onto which OBR (2016) forecasts settle. However, this assumption is not of first-order importance for our result.

¹⁰ We project 8 fiscal items forward at an aggregate level (i.e. we assume that their level grows at 2% per annum from 2021 onwards). These items are labelled in table 1. We have chosen to project these items at an aggregate level, as we believe they are largely invariant to the size and composition of the UK population. We also project state pension payments uniquely to account for planned changes in the state pension age.

GDP is a decline in trade openness, which is assumed to feed through into a decline in investment and labour productivity. They estimate that if EU membership was replaced with a free trade agreement (FTA), similar to that currently being negotiated between the EU and Canada, this would reduce UK real GDP in 2030 by 5.1%, compared to a baseline case of remaining in the EU.

Dhingra et al. (2016a) assess the effect of trade and estimate that, in an 'optimistic' scenario in which the UK obtains full access to the EU single market (European Economic Area [EEA] membership, like Norway), average UK incomes would fall by 1.3% (or £850 per household) following Brexit. Dhingra et al. (2016b) focus on the impact of lower FDI and estimate that a 22% fall in FDI over the next decade – termed a 'conservative' estimate by the authors – could cause a 3.4% decline in real income (or £2200 per household). In related work, Dhingra and Sampson (2016) emphasise the uncertainty about the UK's options outside the EU in the event of Brexit.

The Treasury's recent analysis (HMT, 2016a) estimated that if EU membership were replaced with a FTA this would reduce UK GDP in 2030 by 6.2%, compared to a baseline case of remaining in the EU. HMT (2016a) does not account for changes in migration post-Brexit.

The National Institute's analysis (Baker et al., 2016; Ebell and Warren, 2016) is also set out in table 3. Like the OECD, these studies look both at the long-term impacts and the short-term adjustment process in an integrated framework.¹¹ In the short-term, increased uncertainty leads to a sharp fall in the exchange rate and an increase in risk premia (the cost of financial intermediation) and hence firms' borrowing costs. The increases in risk premia act to tighten monetary and financial conditions. But the exchange rate, which depreciates and possibly overshoots, acts to soften the various blows. Over the longer term, these studies model three scenarios, and their impact on trade in both goods and services and foreign direct investment: a "Norway" scenario (EEA membership), a "Swiss" scenario (with various bilateral agreements with the remaining EU) and an "Island Nation" scenario where we face WTO tariff conditions. These studies incorporate several additional, detailed mechanisms into the adjustment process, including changes in tariff rates and the impact on the capital stock. However, these studies do not account for changes in migration.

Finally, we note that a group called '*Economists for Brexit*' has produced a model-based forecast showing a positive impact on real GDP of withdrawing from the EU, assuming that the UK moved to implement a policy of unilateral free trade (Economists for Brexit, 2016). However, their analysis raises a number of concerns. First, they assume that if the UK leaves the EU then the amount of trade in services will be unchanged. They argue that services are still 'protected' by national governments and so leaving will have little detrimental effect. This is at odds with the assumption in all of the other reports. Second, they model the impact of reduced regulation as equivalent to a reduction of 2% in national insurance contributions; this number appears to be arbitrary. Third, they model a tariff reduction after leaving the EU as a cut in expenditure tax; but the impacts on domestic producers of such a cut would in fact not just be different to that of reducing tariffs, but of the opposite sign. The resulting impact estimates therefore do not appear credible.¹² However, for completeness, we report a fiscal estimate based on the Economists for Brexit (2016) forecast.

¹¹ NIESR, OECD and Treasury all use NiGEM – a macroeconometric model developed at NIESR – for their analysis.

¹² Dhingra et al. (2016c) provide further discussion of the Economists for Brexit (2016) estimates.

Table 3: Comparison of Model-Based Forecasts of the Macroeconomic Effects of Brexit

Institution/Authors	OECD (1)		CEP/LSE (2)		EfB (3)	HM Treasury (4)		NIESR (5)		Oxford Economics (6)		PwC (7)	
Scenario	WTO / FTA	FTA	WTO	WTO	WTO	FTA	WTO	FTA	WTO	FTA	WTO	FTA	WTO
Near-Term Forecast	2020												
GDP	-3.3%	-1.3%	-2.6%	1.7%	-3.6%	-6.0%	-2.1%	-2.9%	n.a.	n.a.	-3.1%	-5.5%	
GDP cost per household	£2,200	£850	£1,700	-£1,100	£2,400	£4,000	£1,400	£2,000	n.a.	n.a.	£2,100	£3,700	
Long-Term Forecast	2030												
GDP	-5.1%	-6.3%	-9.5%	n.a.	-6.2%	-7.5%	-2.1%	-3.2%	-2.0%	-2.7%	-1.2%	-3.5%	
GDP cost per household	£3,200	£4,200	£6,400	n.a.	£4,300	£5,200	£1,400	£2,200	£1,300	£1,800	£600	£1,800	

Transmission Channels Accounted For

Short-term uncertainty	x				x	x	x	x			x	x
Change in trade with EU	x	x	x	x	x	x	x	x	x	x	x	x
Productivity effect from trade	x	x	x	x	x	x			x	x		
Change in FDI	x		x		x	x	x	x	x	x	x	x
Productivity effect from FDI	x		x		x	x			x	x		
Reduced migration	x								x	x	x	x
Gain from deregulation	x			x					x	x	x	x
Lower contribution to EU budget	x	x	x	x	x	x	x	x	x	x	x	x
Model type	NiGEM	Reduced-Form Model		Liverpool	NiGEM		NiGEM		Structural Model		CGE model	

Notes

- (1) OECD (2016) assume that the UK initially trades under WTO rules and then has a FTA with EU (hence one forecast). NiGEM is the National Institute Global Econometric Model.
- (2) CEP/LSE is the Centre for Economic Performance at LSE. See Dhingra et al. (2016a, 2016b). The short-term estimate is based on a static computable general equilibrium model (CGE) and the long term estimates on a dynamic 'reduced form' model that arguably picks-up productivity and FDI effects.
- (3) EfB is Economists for Brexit (2016). They only project out to 2020, but we assume this is a permanent improvement. The Liverpool model is a CGE model.
- (4) HM Treasury is HMT (2016a).
- (5) NIESR is Baker et al. (2016) and Ebell and Warren (2016).
- (6) Oxford Economics produced a long term estimation only using their proprietary model.
- (7) PwC is PwC (2016).

To summarise, there is a degree, albeit not unanimous, of consensus that Brexit would depress UK economic activity in both the short term (via uncertainty) and the long term (via trade). However, it is important to emphasise that all these analyses assume that Brexit will in fact lead to a significant decline in trade with the EU. This is in turn based, explicitly or implicitly, on the historical experience of countries (like the UK) that joined the EU (or the EEA). It is reasonable to question whether the size of the loss in trade is ‘symmetrical’ with the gain in trade of joining the EU (or EEA), or that some of the older data is particularly relevant to today. But the overall direction over time is likely to be clear. It is also important to note, that the model-based estimates mostly include transmission channels that have been discussed throughout the economics literature. There is likely to be UK particular effects which cannot and have not been included in the models (see box 1 below).

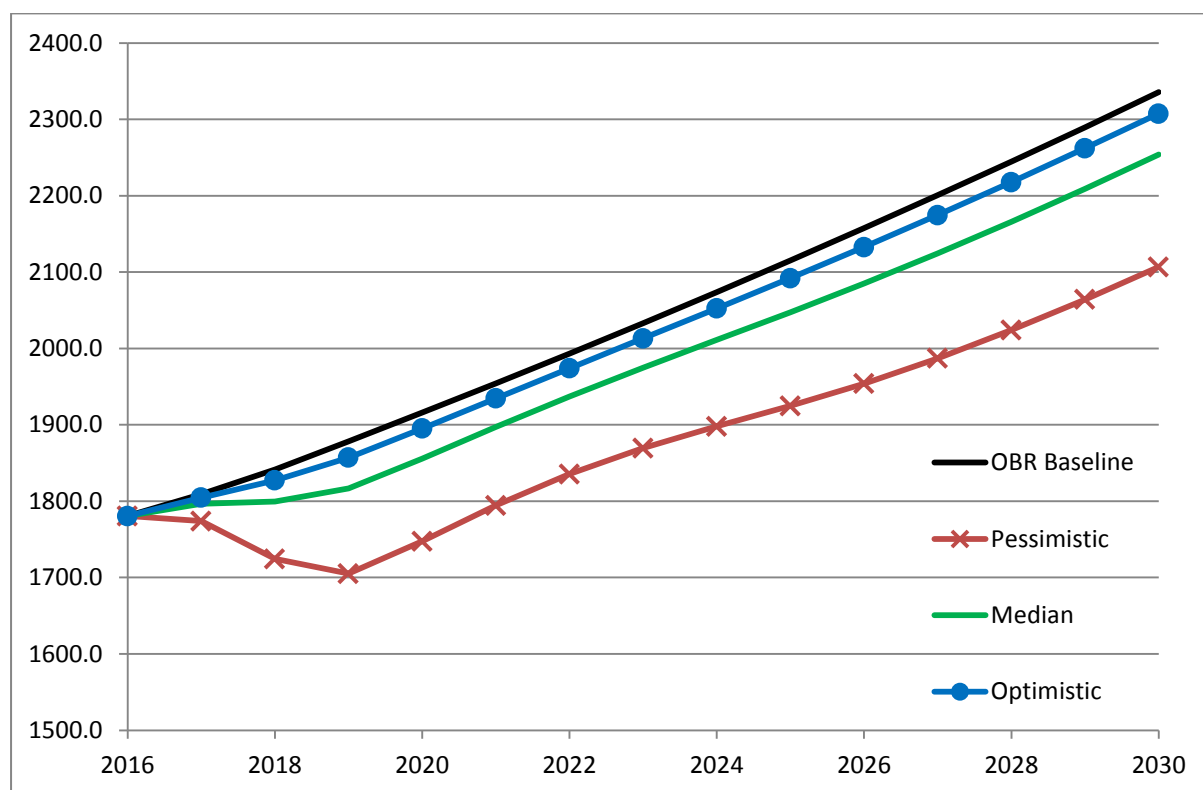
We use the results of aforementioned studies to analyse the effect of Brexit on the fiscal position in the UK. In particular, we consider three alternative paths for real GDP from 2017 onwards to assess the macroeconomic impact of Brexit. We choose the minimum and maximum estimates of the 2030 real GDP loss presented in table 3 and label these as ‘optimistic’ and ‘pessimistic’ Brexit scenarios. In our optimistic scenario, we consider the effect of a 1.2% fall in real GDP in 2030 (estimated by PwC in their Free Trade Agreement scenario), compared to the baseline case of remaining in the EU. In our pessimistic scenario, we consider the effect of a 9.5% fall in real GDP in 2030 relative to the baseline case. This represents the worst-case estimate from CEP/LSE (Dhingra et al., 2016a,b). To provide a central estimate of the fiscal gap due to Brexit, we use the median value of GDP losses presented in table 3. This median scenario corresponds to a 3.5% fall in real GDP in 2030 relative to the baseline case (also estimated by PwC in their WTO scenario). Because all of the macroeconomic scenarios we use as inputs account for lower net contributions to the EU (see table 3), we also consider these as part of our macroeconomic scenario.

To apply these estimates to our model, we approximate a time path for the evolution of real GDP by assuming that the real GDP losses are distributed over time according to estimates from NIESR (2016). Figure 1 presents the implied time paths for real GDP in: (i) a baseline scenario in which real GDP grows at 2% per annum, as per the OBR (2016) forecast; (ii) the optimistic scenario in which real GDP is 1.2% below baseline in 2030; (iii) the median scenario in which real GDP is 3.5% below baseline in 2030; and (iv) the pessimistic scenario in which real GDP is 9.5% below baseline in 2030.¹³

From these approximated time paths, we then constructed implied annual real GDP growth rates from 2017 onwards. We label the difference in growth rates between the baseline and Brexit scenarios as the ‘GDP growth loss’ due to Brexit. Using these figures, we estimate the effects of GDP growth losses on fiscal items, by using point estimates of the elasticity of fiscal revenues and spending with respect to the output gap – i.e. the effect of a 1 percentage point increase in the output gap on each fiscal item. By using these elasticities, we admit heterogeneity in the response of fiscal items to GDP growth. We use the point estimates reported in Helgadottir et al. (2012) – the pertinent figures for this analysis are repeated in table 4.

¹³ The pessimistic scenario is the only scenario in which the UK economy falls into recession (see HMT, 2016b).

Figure 1: Time Paths for Real GDP Projections under the Baseline and Brexit Scenarios in Billions of 2014 Pounds, 2016-2030 Annual



Note: Plot of the macroeconomic scenarios used to estimate the fiscal gap due to Brexit. In the pessimistic scenario real GDP is 9.5% lower than the baseline in 2030. The corresponding figures for the median and optimistic scenarios are 3.5% and 1.2% respectively.

Table 4: Elasticities of Tax and Expenditure Categories to GDP Growth

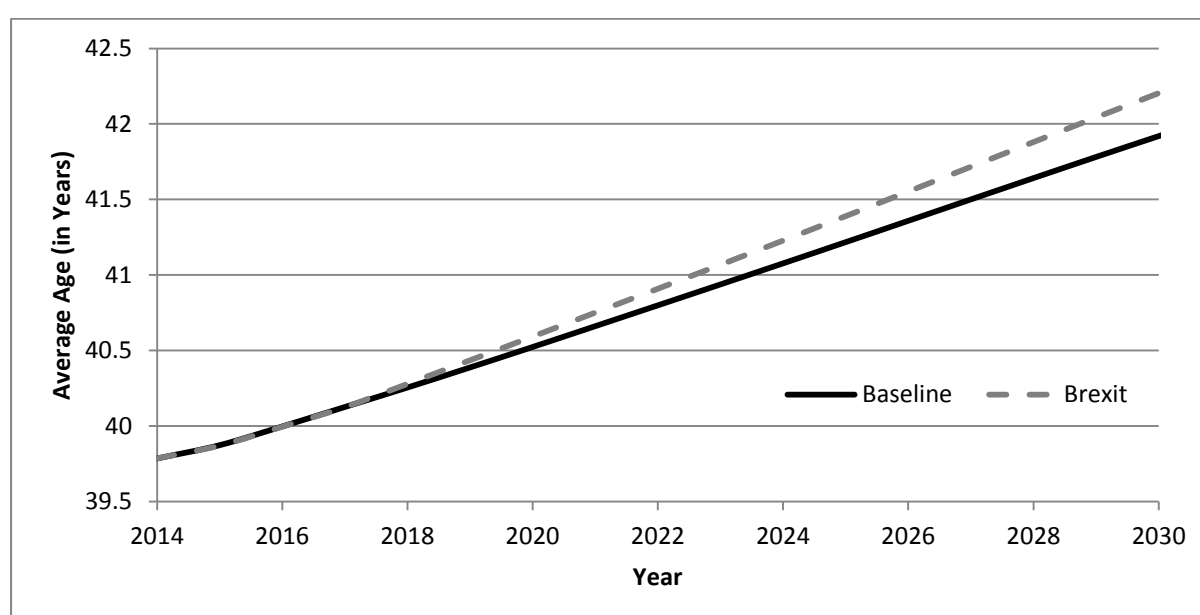
Tax/Expenditure Category	Elasticity
Capital taxes	7.1
Excise duties	1.1
Financial corporation tax	1.8
Fuel duty	1.1
Income Tax	0.9
NI Contributions	0.9
Non-oil, non-financial corporation tax	6.3
VAT	1.1
Total other tax	1.3
Unemployment Spending	-0.1
Total other expenditure	-0.04

Note: Elasticities used in this paper, from Helgadottir et al. (2012), Tables 2.19 and 2.20.

Population Impact: We turn now to a discussion of the impact of Brexit on net migration. A key advantage of our modeling design is its ability to account for both macroeconomic and population changes due to Brexit. To model the impact of population changes, we compare the baseline ONS population projections to a Brexit population projection. We use the Brexit population projection from Lisenkova and Sanchez-Martinez (2016). This projection assumes that net migration from the EU would decline by two-thirds, while net migration from other origins will be unchanged. The assumption is motivated by Migration Watch UK (2016) analysis, which suggests that post-Brexit EU net migration would be around one-third of current levels.

Figures 2 and 3 provide graphical comparisons of the baseline population projection and the Brexit-scenario projection, illustrating the main differences between the two.

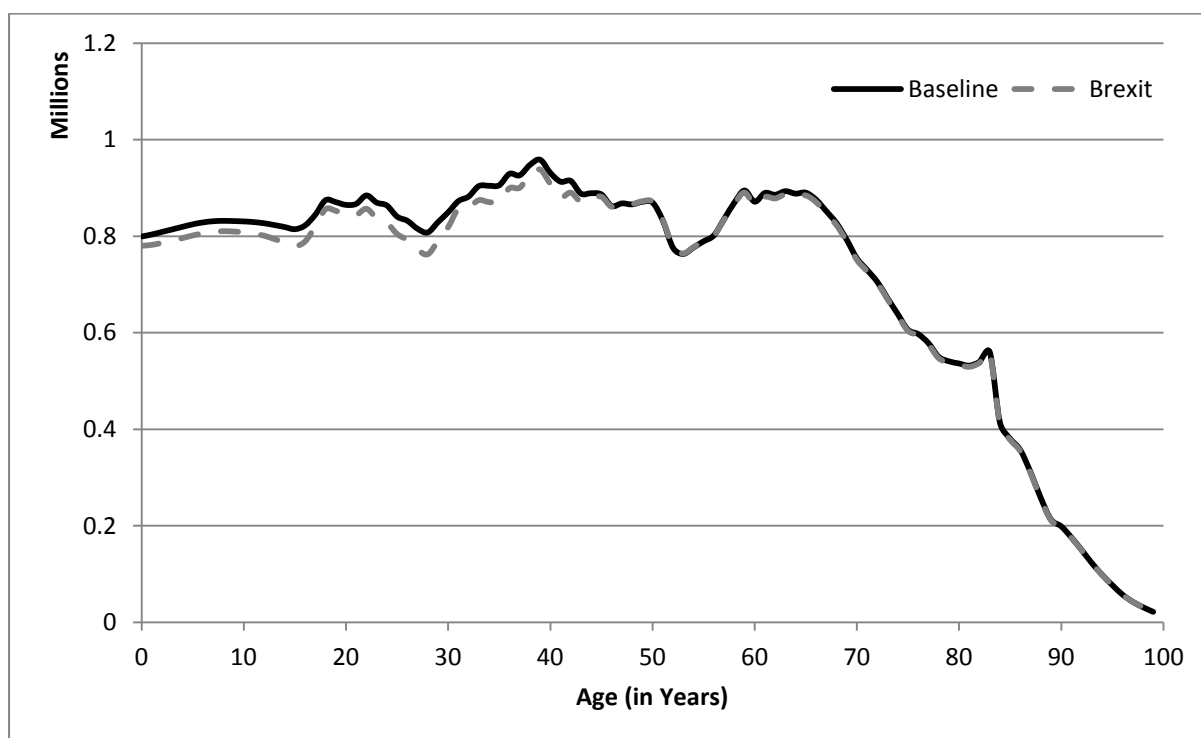
Figure 2: Average Age of Population in the Baseline and Brexit Scenarios



Note: Average population age in each year under the baseline scenario and a Brexit scenario. The baseline population projection is from ONS (2015). The Brexit population projection is from Lisenkova and Sanchez-Martinez (2016).

Figure 2 illustrates that changes in migration under Brexit are projected to increase the average age of the UK population. Figure 3 demonstrates the projected change in the population distribution by age, suggesting that the average age of the population is projected to increase due to fewer children and people of working age, rather than an increase in the number of pensioners relative to baseline. Understanding these changes in population composition helps to shed light on the fiscal outcomes in the Brexit scenario. In particular, the changes in population presented in figures 2 and 3 might be expected to exert two distinct long-run effects on the fiscal gap under Brexit. First, with fewer people of working age in the population, a tax revenue shortfall may open up relative to baseline. Second, with a higher average population age, this may place pressure on fiscal spending.

Figure 3: Population Distribution by Age in 2030 under the Baseline and Brexit Scenarios



Note: Millions of people in 2030 of each age under the baseline scenario and a Brexit scenario. The baseline population projection is from ONS (2015). The Brexit population projection is from Lisenkova and Sanchez-Martinez (2016).

4. Technical Methodology for Estimating the Fiscal Gap Due to Brexit

This section provides a technical description of our methodology for both the baseline and Brexit scenarios for the interested reader. Those less interested in the technical details can skip to section 5.

2014-2016: Calculating the Distribution of Fiscal Items by Age and Gender

Between 2014 and 2016, projections for each tax and transfer listed in table 1 are provided by the OBR (2015, 2016) and DWP (2016) at an aggregate level. We use these projections, along with the age profiles and population structure, to calculate the distribution of tax and transfer payments by age and gender between 2014 and 2016. To do this, define $T_{t,i}$ as the total aggregate (projected) value of fiscal item i in year t . The value of the i -th fiscal item for individuals of age a ($a = 0, 1, \dots, 101$) and gender m ($m = 1, 2$) at time t is labelled $T_{t,i}^{a,m}$ and is calculated in the following manner:

$$T_{t,i}^{a,m} = T_{t,i} \cdot f_i^m \cdot s_i^{a|m} \quad (1)$$

where f_i^m is the fraction of fiscal item i paid or received by individuals of gender m , and $s_i^{a|m}$ is the fraction of fiscal item i paid or received by individuals of age a , given their m -th gender.¹⁴

2017-2020: Accounting for Brexit Given Baseline Aggregate Projections

Our Brexit scenarios begin in 2017. However, between 2017 and 2020, our dataset also includes aggregate projections for all fiscal items listed in table 1. These calculations, from OBR (2015, 2016) and DWP (2016), are constructed assuming that Brexit does not occur. Thus, for our baseline case – when Brexit does not occur – we use these projections to calculate the distribution of each fiscal item by age and gender. However, in the event of Brexit, the aggregate projections for fiscal items will change along with the distribution by age and gender. We design a strategy to account for these two cases in a consistent manner. By doing this, we are able to attain projections for aggregate fiscal items whilst also using OBR and DWP information on planned government policy changes. The strategy proceeds in five steps.

First, we take the total projected aggregate value of fiscal item i in year t , $T_{t,i}$, and use it to calculate the distribution of fiscal item i in year t by age and gender, $T_{t,i}^{a,m}$, using equation (1). We do this for all fiscal items i and years $t = 2017, \dots, 2020$.

Second, we calculate the annual (net) growth rate of the per capita fiscal item i in year t for individuals of age a and gender m , $g_{t,i}^{a,m}$, that is implied by the OBR-DWP aggregate projection, population structure, and age and gender profiles. This is given by

$$1 + g_{t,i}^{a,m} = \frac{T_{t,i}^{a,m} / N_{t,i}^{a,m}}{T_{t-1,i}^{a,m} / N_{t-1,i}^{a,m}} \quad \forall i, a, m, \text{ and } t = 2017, \dots, 2020 \quad (2)$$

where $N_t^{a,m}$ denotes the number of individuals of age a and gender m in year t .

Third, for each specific scenario s , we calculate the projected distribution of each fiscal item i by age and gender, for $t = 2017, \dots, 2020$, using

$$T_{t,i}^{a,m} = \frac{T_{t-1,i}^{a,m}}{N_{t-1,i}^{a,m}} \cdot (1 + g_{t,i}^{a,m} - \varepsilon_i \Delta g_{t,s}) \cdot N_{t,s}^{a,m} \quad (3)$$

where $\Delta g_{t,s}$ denotes the growth loss in year t under scenario s . In the baseline scenario, $s = base$, with no Brexit, $\hat{g}_{t,s} = 0$ for all t and s .¹⁵ The estimated elasticity of fiscal item i with respect to the GDP growth rate is denoted by ε_i . Because we also account for the effects of changes in population composition in our scenarios, $N_{t,s}^{a,m}$ denotes the population projection in year t under scenario s for individuals of age a and gender m .

Fourth, once the projected values of each fiscal item are calculated for individuals of both genders and all ages, the aggregate spending or revenue in any category in any given year, and scenario s , is equal to the sum over all age groups and genders:

¹⁴ Because the sum of f_i^m across all m , and the sum of $s_i^{a|m}$ across all a are defined to sum to unity, the sum of $T_{t,i}^{a,m}$ across all a and all m is, by definition, equal to $T_{t,i}$.

¹⁵ This ensures that, in our baseline scenario, our implied projections are consistent with the projections of the OBR (2015, 2016) and DWP (2016) for the 2017-20 period.

$$T_{t,i,s} = \sum_{a=0}^{101} \sum_{m=1}^2 T_{t,i,s}^{a,m} \quad (4)$$

2021 Onwards: Projecting Aggregate Fiscal Items and Accounting for Brexit

Beyond 2020, there are no projections for the aggregate spending or revenue in any fiscal category. To form these projections, we assume that government receipts and expenditure per capita for each fiscal item, at each age and gender, grow at an assumed long-run growth rate g .¹⁶ In the event of Brexit, we perturb this quantity g by the growth loss in year t under scenario s , $\Delta g_{t,s}$. Thus, the value of fiscal item i in year t (where $t > 2020$) for individuals of age a and gender m , under scenario s , is calculated as:

$$T_{t,i,s}^{a,m} = \frac{T_{t-1,i,s}^{a,m}}{N_{t-1,s}^{a,m}} \cdot (1 + g - \varepsilon_i \Delta g_{t,s}) \cdot N_{t,s}^{a,m} \quad (5)$$

We use equation (4) to calculate the projection of aggregate spending or revenue associated with fiscal item i .

There are two exceptions to this projection rule. First, we project six fiscal items beyond 2020 using an aggregate growth rule. That is, the aggregate spending or revenue associated with these items grows at a rate that is independent of the structure or size of the population. These six items are labeled in table 1. Second, we calculate projections for state pension spending in a manner that accounts for planned changes in the state pension age. This means that the projected total pension bill is a function of changes in the population size and structure, as well as changing pension entitlement over time. The mathematical details underlying these two exceptions are presented in appendix A.

5. Results – The Fiscal Gap Due to Brexit

The Macroeconomic Effects of Brexit

We first assess the fiscal impact of Brexit due to macroeconomic effects, including changes in net contributions to the EU. Figure 4 presents the headline result from this analysis, plotting the fiscal gap arising from the macroeconomic effects of Brexit relative to the baseline – i.e. the increase in the UK fiscal deficit attributable to the macroeconomic effects of Brexit. All figures are presented as a percentage of baseline real GDP in each year.

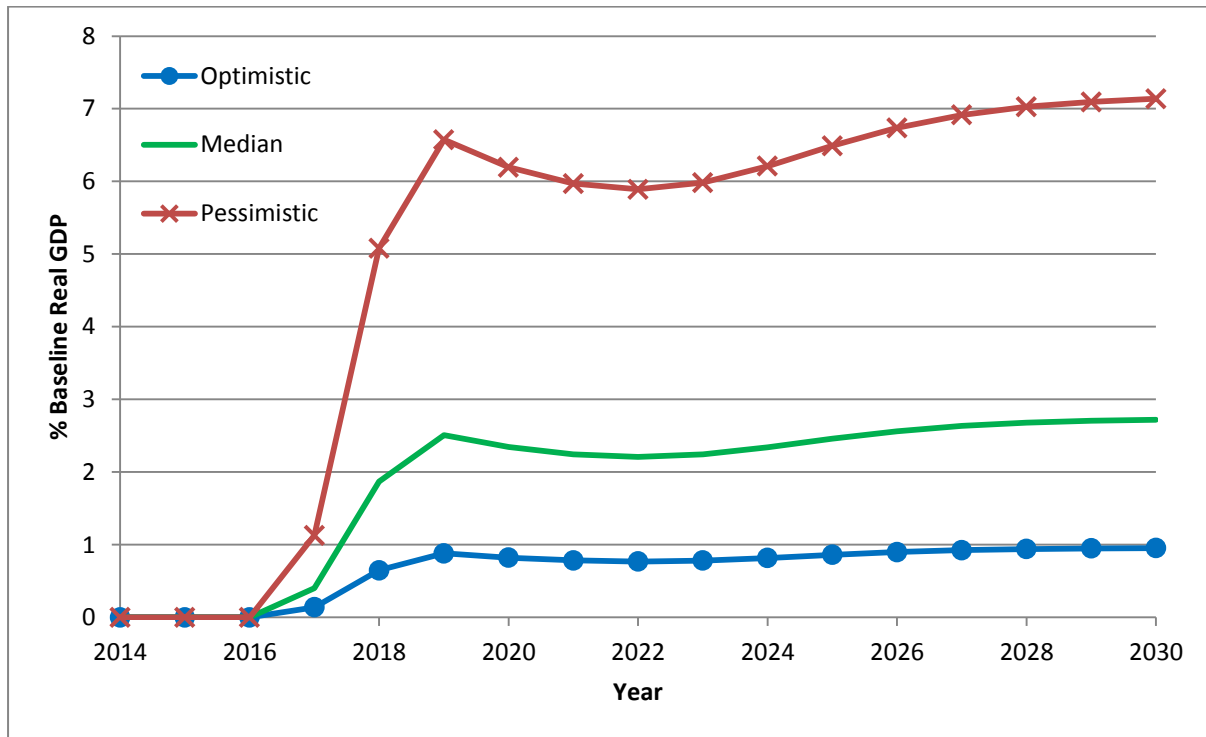
Figure 4 demonstrates that, following Brexit, the macroeconomic losses are predicted to unambiguously worsen the government fiscal position in both the optimistic and the pessimistic cases. By 2030, the model predicts that following Brexit the fiscal deficit will be between 0.95% and 7.14% larger – with a central estimate of 2.72% – relative to the baseline case (or, equivalently, the fiscal surplus will be smaller).

Perhaps most strikingly, the majority of the fiscal impact is predicted to occur before the end of the current parliament. In 2020, the fiscal deficit is predicted to be between 0.82% and 6.19% larger – with a central estimate of 2.35% – than the baseline. That is, around 86% of the fiscal gap arising

¹⁶ We set this growth rate to 2% per annum, approximately the growth rate the OBR's central forecasts for real GDP growth and labour productivity settle on. This assumption is not of first-order importance for our results.

from Brexit’s macroeconomic effects is predicted to have opened up by 2020. Given the current UK Fiscal Charter, this is likely to have important implications for welfare spending and thus support for low income families. The UK Fiscal Charter mandates that the “target for public sector net debt as a percentage of GDP” should fall in each year to 2019-20. Therefore, the UK government will need to adjust fiscal spending and taxation to fill the shortfall under the Fiscal Charter.

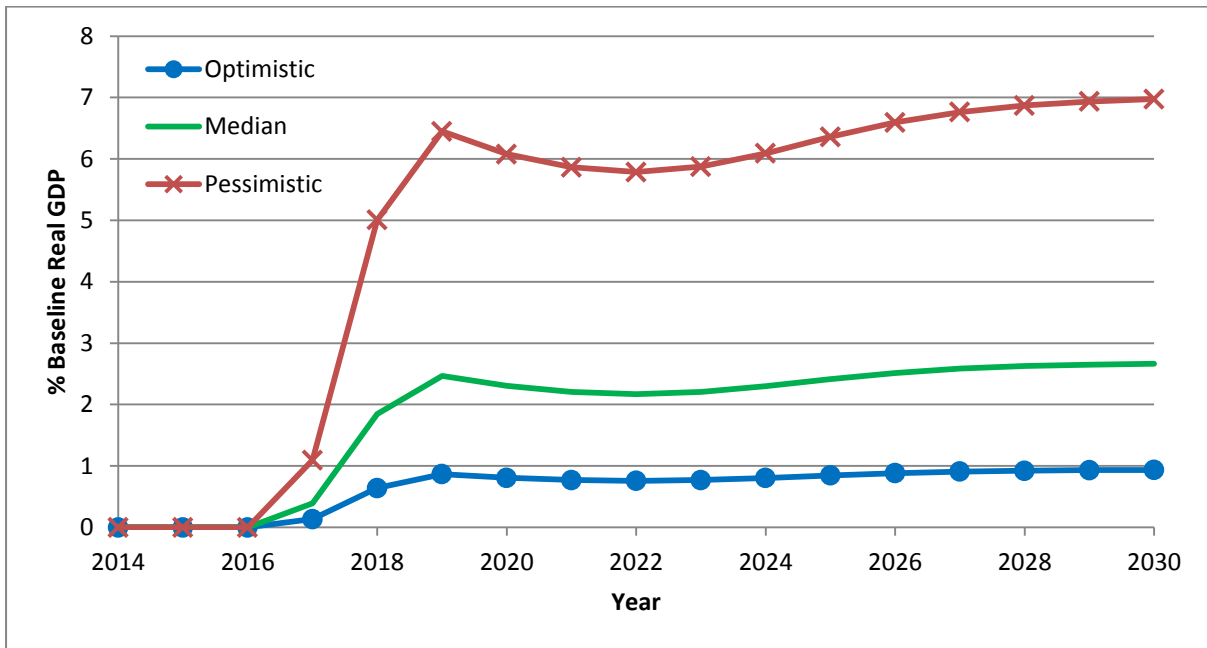
Figure 4: Deficit Gap Due to the Macroeconomic Economic Effects of Brexit as a Percentage of Baseline Real GDP



Note: The estimated increase in the UK fiscal deficit attributable to the macroeconomic effects of Brexit relative to the baseline (accounting for changes in net contributions to the EU). In the pessimistic scenario real GDP is 9.5% lower than the baseline in 2030. The corresponding figures for the median and optimistic scenarios are 3.5% and 1.2% respectively. All figures are expressed as a percentage of baseline real GDP in each year.

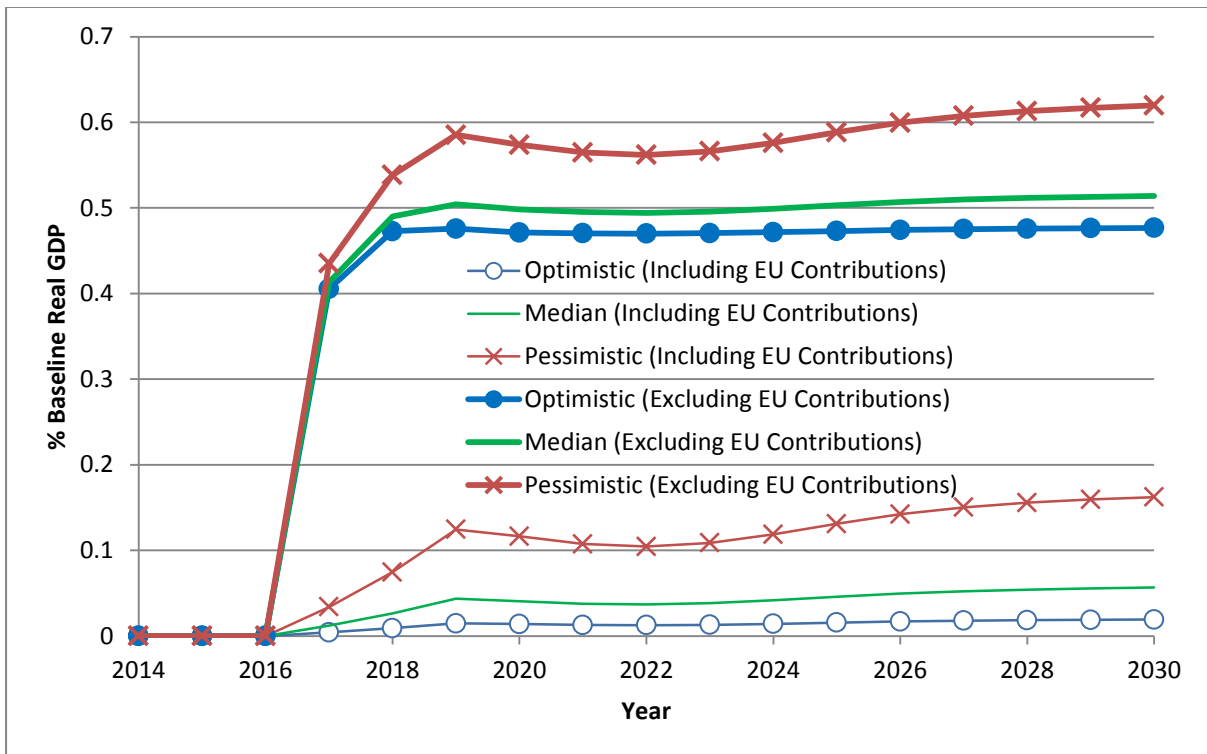
Decomposing the changes in figure 4 further, figures 5 and 6 present the tax revenue shortfall and excess spending predicted under Brexit, relative to the baseline case. The figures highlight that the majority of the fiscal gap emanates from reduced tax revenue. In particular, the tax revenue shortfall under Brexit is predicted to lie between 0.94% and 6.97% of baseline real GDP by 2030. Fiscal spending is predicted to rise above the baseline level, even when the removal of net EU contributions is accounted for. The reason for that is negative elasticity of fiscal spending categories with respect to output gap (see table 4). This means that an increase in output gap leads to an increase in fiscal spending (countercyclical response).

Figure 5: Fiscal Revenue Shortfall as a Percentage of Baseline Real GDP



Note: The estimated decrease in UK fiscal revenues attributable to the macroeconomic effects of Brexit relative to the baseline (accounting for changes in net contributions to the EU). All figures are expressed as a percentage of baseline real GDP in each year.

Figure 6: Extra Spending as a Percentage of Baseline Real GDP

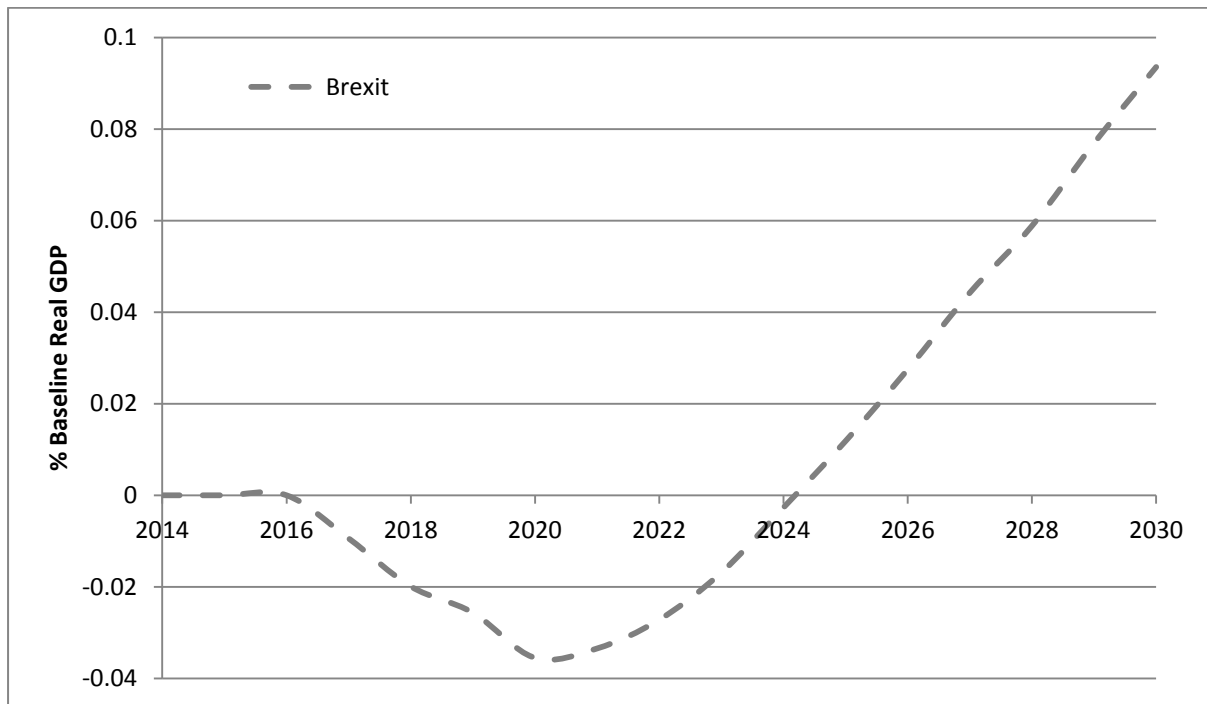


Note: The estimated increase in UK fiscal spending attributable to the macroeconomic effects of Brexit relative to the baseline (accounting for changes in net contributions to the EU). All figures are expressed as a percentage of baseline real GDP in each year.

The Migration Effects of Brexit

We assess the effects of projected post-Brexit population trends independently of the macroeconomic impact of Brexit. To do this, we assume that the economy grows at the baseline level and compare the outcomes under the baseline, ONS population projection to the outcomes under the Brexit population projection. Figure 7 presents the headline result from this comparison: the fiscal gap due to the population effects of Brexit.

Figure 7: Fiscal Gap Due to the Population Effects of Brexit Relative to Baseline as a Percentage of Baseline GDP



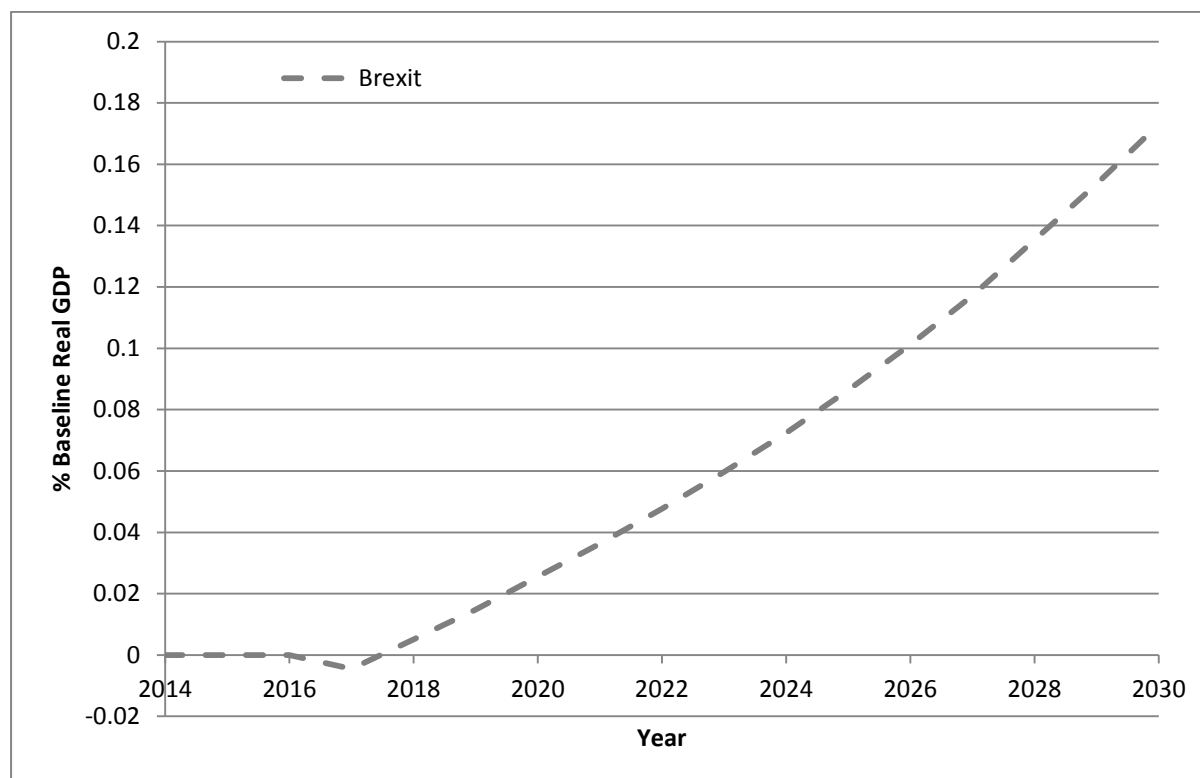
Note: The estimated increase in the UK fiscal deficit attributable to the migration effects of Brexit relative to the baseline. All figures are expressed as a percentage of baseline real GDP in each year.

The population impact is quantitatively smaller than the macroeconomic impact. By 2030, population changes are predicted to open a fiscal shortfall of 0.09% of baseline real GDP. Moreover, the population impact is no longer qualitatively unambiguous. The fiscal gap is first predicted to improve to 0.04% of GDP in 2020, before worsening thereafter.

Again, the primary driver of this change is taxation revenue. In particular, projected changes in income tax revenues explain a large proportion of the changes presented in figure 7. Figure 8 depicts the projected income tax revenue shortfall due to population changes. From 2018 onwards, income tax revenues are projected to fall due to population changes relative to the baseline. By 2030, the income tax revenue shortfall due to population alone is predicted to be 0.17% of baseline real GDP. In the light of the changing population structures depicted in figures 2 and 3, this can be explained

by: (i) the smaller quantity of working age population; and (ii) the increased average age of the population in the Brexit scenario.¹⁷

Figure 8: Income Tax Revenue Gap as a Percentage of Baseline Real GDP



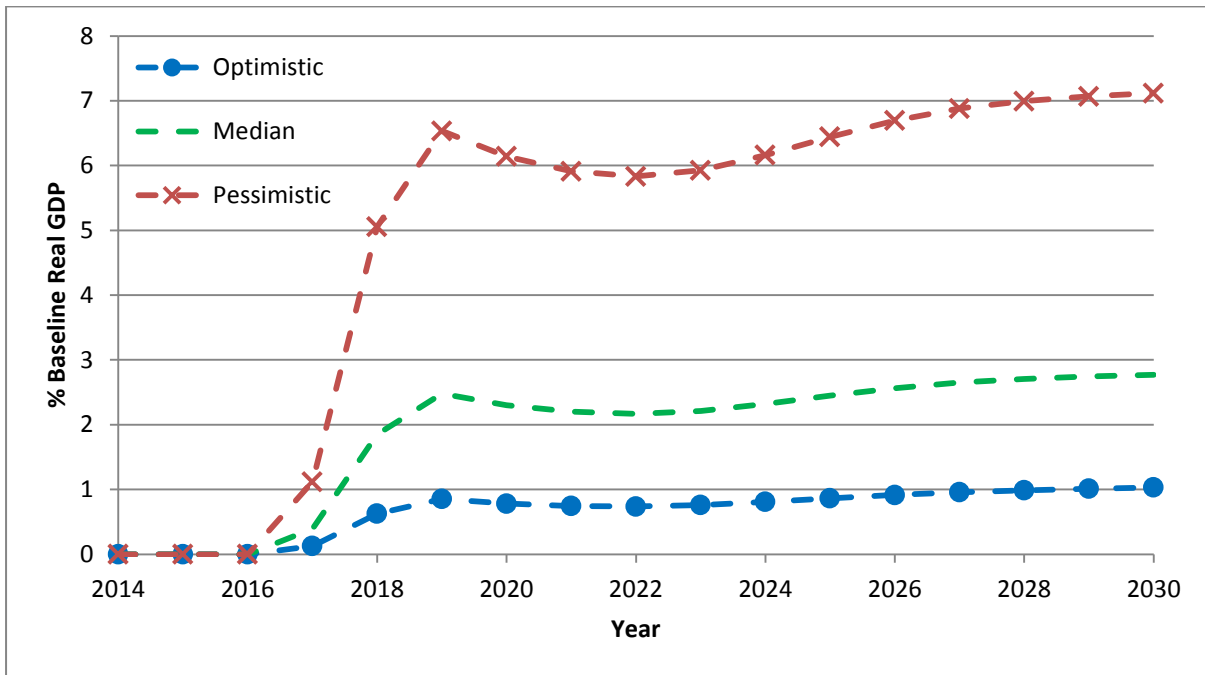
Note: The estimated decrease in UK income tax revenues attributable to the migration effects of Brexit relative to the baseline. All figures are expressed as a percentage of baseline real GDP in each year.

The Joint Macroeconomic and Population Effects of Brexit

Figure 9 depicts the headline effects of Brexit on the UK fiscal position when both macroeconomic and population effects are accounted for. Following Brexit the deficit is predicted to be between 1.03% and 7.12% of baseline real GDP larger in 2030 in the optimistic and pessimistic scenarios respectively. The central estimate for the fiscal shortfall, estimated using the median macroeconomic scenario is 2.30% of baseline GDP in 2020 and 2.77% in 2030. Hereafter, we use these estimates of the fiscal shortfall to calculate estimates of the cost of Brexit for low income households.

¹⁷ We view these estimates of the fiscal gap due to the migration effects of Brexit to be a lower bound. In comparison to Lisenkova and Sanchez-Martinez (2016), we estimate smaller effects of migration on the UK fiscal balance sheet. These differences can be reconciled by the differences in modelling strategy and data inputs. In particular, unlike Lisenkova and Sanchez-Martinez (2016), we are unable to account for heterogeneity of labour market characteristics of migrants and UK population.

Figure 9: Deficit Gap Due to the Macroeconomic and Population Effects of Brexit as a Percentage of Baseline Real GDP



Note: The estimated increase in the UK fiscal deficit attributable to the macroeconomic and migration effects of Brexit relative to the baseline (accounting for changes in net contributions to the EU). In the pessimistic scenario real GDP is 9.5% lower than the baseline in 2030. The corresponding figures for the median and optimistic scenarios are 3.5% and 1.2% respectively. All figures are expressed as a percentage of baseline real GDP in each year.

6. Results – The Effects of the Fiscal Shortfall on Low Income Families

In this section, we use the fiscal projections from section 5 to quantitatively evaluate the fiscal impact of Brexit on low income families. To do this, we ask: how will changes in fiscal taxation and spending, necessary to fill the fiscal shortfall due to Brexit, influence the benefit payments received by low-income families.

The analysis proceeds in three stages. First, we calculate the average tax credit and benefit payments received by low income households. We define a low income household as one which receives tax credit or Jobseeker’s allowance. Second, we construct scenarios that capture necessary changes in the UK government’s fiscal stance in order to cover the fiscal shortfall calculated in section 5. Third, we impute the effect of these fiscal changes on the benefit receipts of low income households, using the calculations from step 1.

Average Benefit Payments to Low Income Households

To calculate average annual benefit payments to low income households, we combine data from two sources: the UK Labour Force Survey (LFS), and the administrative benefits data from the DWP. We use the 2014 Q4 LFS (ONS, 2014) and data from the DWP Tabulation Tool (DWP, 2015) in accordance with the base year of our analysis. That is, we calculate average annual benefit payments using 2014 legislation in 2014 prices.

Given data availability, we calculate the average payments of eight benefit items to low income households: tax credit (working tax and child tax credit); child benefit; carer's allowance; disability living allowance; income support; housing benefit and jobseeker's allowance. These categories of benefits cover 96% of welfare spending on working age adults in 2014. Because data availability prevents us from measuring every benefit item, our figures represent a lower bound for the tax credit and benefit receipts of low income households and thus a lower bound for the tax credit and benefit losses due to Brexit.

We calculate the average payments of each benefit to eight categories of low income households: single adults of working age with no children; single adults with no children and a disability; a couple of working age with no children and no disabilities; a couple of working age with one child and no disabilities; a couple of working age with two children and no disabilities; a lone parent of working age with one child and no disabilities; a lone parent of working age with two children and no disabilities; and a single adult of working age with no children and receiving Jobseeker's allowance. This decomposition of households can be inferred from the data in the LFS.

Using information in the LFS, we construct the eight distinct groups of households and impute household working tax credit receipts using the 2016 regulations (with values deflated to 2014 pounds).¹⁸ This provides the average working tax credit receipts for each group of low income household, accounting for hours worked and gross annual household income. We also impute child tax credit and child benefit receipts for households with children, as per the 2016 regulations (with values deflated to 2014 pounds).

To calculate average annual jobseeker's allowance receipts, we assume that an unemployed individual is in receipt of this benefit for six months. This choice of duration is informed by DWP (2015) data: two-thirds of jobseeker's allowance recipients receive the benefit for 1 year or less. Of these, the mean duration is 6 months.¹⁹

To calculate average payments of the remaining six benefits, we use DWP data on the average weekly payments to claimants of different ages. The LFS only provides binary information about these benefits – i.e. whether a household claims the benefit or not. We use this binary information to measure the share of low income households that receive each benefit. By combining this with the DWP data, we calculate the annual benefit payments to the 'average person' in each group of low income families.

Table 5 presents the results of this analysis, providing the average annual benefit payments received by different low income groups. It shows that, of all the low income households, lone parents with two children were the highest recipients of benefits on average in absolute terms. Single unemployed working age adults were the highest recipients of benefit payments as a proportion of household income. Couples of working age with no children received the lowest amount of benefits on average, in absolute terms and as a proportion of household income.

¹⁸ Information on tax credit regulations and eligibility is provided in appendix B.

¹⁹ We omit individuals who receive benefits for a longer duration because DWP (2015) data does not provide sufficient detail regarding the duration over which benefits were received for this group. To the extent that the omitted group includes low income households in receipt of Jobseeker's Allowance in excess of six-months, our estimates can be taken as a lower bound.

Table 5: Average Annual Benefit Payments to Low-Income Groups, 2014, 2014-£

	Single, Working Age, No Children	Single, Disabled, No Children	Couple, Working Age, No Children	Couple, Working Age, 1 Child	Couple, Working Age, 2 Children	Lone, Working Age, 1 Child	Lone, Working Age, 2 Children	Single, Unemployed, No Children
Total Tax Credit	£4,388.36	£6,777.09	£4,073.30	£6,768.49	£9,421.66	£6,098.15	£8,461.49	£0.00
Child Benefit	£0.00	£0.00	£0.00	£1,066.00	£1,770.60	£1,066.00	£1,770.60	£0.00
Carer's Allowance	£86.63	£25.77	£32.21	£109.30	£64.28	£67.49	£115.67	£54.75
Disability Living Allowance	£0.00	£1,598.62	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00
Income Support	£21.08	£152.06	£0.00	£70.72	£33.89	£799.79	£711.08	£26.84
Housing Benefit	£1,417.42	£2,252.22	£479.70	£1,063.71	£646.93	£3,260.76	£2,599.06	£3,554.46
Jobseeker's Allowance	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£1,863.58
Total Benefit Income	£5,913.49	£10,805.77	£4,585.21	£9,078.23	£11,937.36	£11,292.19	£13,657.91	£5,499.63
% of Gross Annual Household Income	34.16%	55.56%	28.72%	41.87%	45.62%	50.38%	56.27%	72.96%

Note: Average annual benefit payments to different groups of low income households. Low income households are defined as households in receipt of working tax credit. The calculations are made using data from the Labour Force Survey (ONS, 2014) and DWP (2014).

Changes in Fiscal Items to Close the Fiscal Gap

In section 5, we calculate the fiscal gap due to Brexit – when accounting for macroeconomic factors, changes in net payments to the EU and population changes – to be between £15.0bn and £117.6bn in 2020, and £24.1bn and £166.2bn in 2030 (in 2014 £). Our central estimates, using the median macroeconomic scenario, are £44.1bn in 2020 and £64.7bn in 2030.

In contrast, we project that, in the baseline scenario, welfare spending – including tax credits, but excluding pensions – will be £108.7bn in 2020 and £142.9bn in 2030 (2014 £). That is, we project that in 2020 the fiscal shortfall due to Brexit will be 41% (range: 14%-108%) of the projected baseline value of the welfare budget in 2020. The corresponding value for 2030 is 45% (range: 17%-116%).

We assume that the government will seek to close the fiscal shortfall due to Brexit, necessitating changes in fiscal spending and taxation. In light of the UK Fiscal Charter, which protects certain areas of government spending, and recent historical changes in UK welfare spending under the Fiscal Charter, it is likely that welfare spending will bear some of the burden of fiscal adjustment due to Brexit. We consider four scenarios: when welfare spending bears 25%, 50%, 75% and 100% of the burden of fiscal adjustment to fill the fiscal shortfall due to Brexit. We assume that all elements of welfare spending fall equi-proportionally.²⁰

The Effect of Fiscal Changes on Low Income Households

Tables 6 and 7 present the estimated falls in the average annual tax credit and benefit receipts of low income households when welfare spending must bear differing degrees of the burden of fiscal adjustment necessary to fill the fiscal shortfall due to Brexit.

We estimate, using our central estimate of the fiscal shortfall, that when welfare spending bears 100% of the burden of fiscal adjustment due to Brexit, the average annual tax credit and benefit receipts of a low income households comprised a single, working age adult with no disability and no child, will fall by £2,400 in 2020 (in 2014 £). The figure ranges from £816 to £5,913 per year in the optimistic and pessimistic scenarios respectively. The corresponding figure for 2030 is £2,678, ranging from £998 to £5,913 per year in the optimistic and pessimistic scenarios respectively.

In absolute terms, lone parents with two children stand to lose the most from changes in welfare spending due to Brexit. Even when the welfare budget bears just 25% of the fiscal adjustment to fill the fiscal shortfall due to Brexit, this group stands to lose £1,386 a year in 2020 (range: £471-£3,695) and £1,546 a year in 2030 (range: £576-£3,972). As a percentage of gross annual household income, unemployed individuals stand to lose the most from changes in welfare spending due to Brexit. When the welfare budget bears 50% of the fiscal adjustment, this group stands to lose £1,116 a year in 2020 (range: £379 to £2,976), and £1,245 a year in 2030 (range: £464 to £3,199).

²⁰ When using our pessimistic estimate of the fiscal shortfall of £117.6bn in 2020, we consider scenarios where welfare spending falls by £29.4bn, £58.8bn and £88.2bn when welfare spending bears 25%, 50% and 75% of the adjustment burden. Because in this case the fiscal shortfall exceeds to welfare budget (£108.7bn), we consider a £108.7bn fall in welfare spending when this bears 100% of the adjustment burden.

Table 6: Estimated Loss in Annual Tax Credit and Benefit Receipts of Low Income Households (2014 Pounds) Due to the Fiscal Impact of Brexit if the Welfare Budget is Cut, Bearing x% of the Fiscal Adjustment in 2020

Burden: Welfare Budget x%	Single, Working Age, No Children	Single, Disabled, No Children	Couple, Working Age, No Children	Couple, Working Age, 1 Child	Couple, Working Age, 2 Children	Lone Parent, Working Age, 1 Child	Lone Parent, Working Age, 2 Children	Single, Unemployed, No Children	
25%	C	£600	£1,096	£465	£921	£1,211	£1,146	£1,386	£558
	R	£204 to £1,600	£373 to £2,923	£158 to £1,240	£313 to £2,456	£412 to £3,229	£390 to £3,055	£471 to £3,695	£190 to £1,488
50%	C	£1,200	£2,192	£930	£1,842	£2,422	£2,291	£2,771	£1,116
	R	£408 to £3,199	£746 to £5,846	£316 to £2,481	£626 to £4,912	£824 to £6,459	£779 to £6,110	£942 to £7,390	£379 to £2,976
75%	C	£1,800	£3,289	£1,396	£2,763	£3,633	£3,437	£4,157	£1,674
	R	£612 to £4,799	£1,118 to £8,880	£475 to £3,721	£940 to £7,368	£1,236 to £9,688	£1,169 to £9,164	£1,414 to £11,084	£569 to £4,463
100%	C	£2,400	£4,385	£1,861	£3,684	£4,844	£4,582	£5,542	£2,232
	R	£816 to £5,913	£1,491 to £10,806	£633 to £4,585	£1,253 to £9,078	£1,647 to £11,937	£1,558 to £11,292	£1,885 to £13,658	£759 to £5,500

Note: Estimated annual fall in the tax credit and benefit receipts of different classes of low income households in 2020 due to the macroeconomic and migration effects of Brexit on the UK fiscal position. The burden of adjustment denotes the fraction of the fiscal shortfall filled by cuts in the welfare budget. The central estimate (denoted by 'C') is calculated using the median macroeconomic scenario, while the range (denoted by 'R') is calculated using the optimistic and pessimistic scenarios respectively.

Table 7: Estimated Loss in Annual Tax Credit and Benefit Receipts of Low Income Households (2014 Pounds) Due to the Fiscal Impact of Brexit if the Welfare Budget is Cut, Bearing x% of the Fiscal Adjustment in 2030

Burden: Welfare Budget x%	Single, Working Age, No Children	Single, Disabled, No Children	Couple, Working Age, No Children	Couple, Working Age, 1 Child	Couple, Working Age, 2 Children	Lone Parent, Working Age, 1 Child	Lone Parent, Working Age, 2 Children	Single, Unemployed, No Children	
25%	C	£669	£1,223	£519	£1,028	£1,351	£1,278	£1,546	£623
	R	£250 to £1,720	£456 to £3,142	£194 to £1,333	£383 to £2,640	£504 to £3,471	£477 to £3,284	£576 to £3,972	£232 to £1,599
50%	C	£1,339	£2,446	£1,038	£2,055	£2,703	£2,557	£3,092	£1,245
	R	£499 to £3,439	£912 to £6,285	£387 to £2,667	£766 to £5,280	£1,008 to £6,943	£953 to £6,568	£1,153 to £7,943	£464 to £3,199
75%	C	£2,008	£3,670	£1,557	£3,083	£4,054	£3,835	£4,638	£1,868
	R	£749 to £5,159	£1,368 to £9,427	£580 to £4,000	£1,149 to £7,920	£1,511 to £10,414	£1,430 to £9,851	£1,729 to £11,915	£696 to £4,798
100%	C	£2,678	£4,893	£2,076	£4,111	£5,405	£5,113	£6,184	£2,490
	R	£998 to £5,913	£1,824 to £10,806	£774 to £4,585	£1,532 to £9,078	£2,015 to £11,937	£1,906 to £11,292	£2,305 to £13,658	£928 to £5,500

Note: Estimated annual fall in the tax credit and benefit receipts of different classes of low income households in 2030 due to the macroeconomic and migration effects of Brexit on the UK fiscal position. The burden of adjustment denotes the fraction of the fiscal shortfall filled by cuts in the welfare budget. The central estimate (denoted by 'C') is calculated using the median macroeconomic scenario, while the range (denoted by 'R') is calculated using the optimistic and pessimistic scenarios respectively.

Box 1: Economists for Brexit

In table 3, we report that a group called ‘Economists for Brexit’ has produced a model-based forecast estimating a positive impact on real GDP of withdrawing from the EU (Economists for Brexit, 2016). This estimate assumed that the UK moved to implement a policy of unilateral free trade. We estimate the fiscal gap due to Brexit using the Economists for Brexit (2016) estimates. Economists for Brexit (2016) provide GDP growth figures for both a no-Brexit and Brexit scenario to 2020. From these growth rates we calculate the implied level of GDP under both scenarios and the difference between them, which amounts to 1.7% in 2020. As Economists for Brexit (2016) do not provide figures for 2020-30, we only report estimates of the fiscal gap in 2020. We also account for projected population changes in the calculation.

By carrying out this analysis, we estimate that the fiscal gap due to Brexit under the Economists for Brexit (2016) scenario will be -1.1% of baseline GDP in 2020, That is, the projected fiscal surplus is 1.1% of baseline GDP larger in 2020. This figure is explained by changes in both tax revenue and spending relative to the baseline. We estimate that tax revenue will be 0.93% of baseline real GDP higher, and spending 0.18% of baseline real GDP lower, under this scenario.

Despite this projected fiscal surplus, we do not believe that it will have positive effect on the tax credit and benefit receipts of the low income families. The reason is that the Fiscal Charter prioritises debt reduction. Therefore, it is unlikely that additional surplus will be used to increase welfare spending.

7. Conclusion

In this paper, we assess the impact of Brexit on the benefit and tax credit receipts of low income households using detailed UK fiscal and population data.

We quantify the effects of leaving the EU on the UK fiscal position from two major sources: (i) the impact of Brexit on national income and (ii) possible changes in migration. We also account to the changes in net contributions to the EU. We use post-Brexit GDP and migration projections as inputs to our model. Because a wide range of macroeconomic post-Brexit forecasts exist in the public domain, we account for three GDP projections in our analysis. To ensure that our results are robust to the differing assumptions in existing macroeconomic studies of Brexit we choose the most optimistic, the most pessimistic and the median estimates of GDP losses due to Brexit as model inputs. We find, using the median estimate for GDP and population projections from Lisenkova and Sanchez-Martinez (2016), that by 2020 the fiscal deficit will be 2.3% of baseline real GDP higher following Brexit. The corresponding range for the optimistic and pessimistic macroeconomic scenarios is 0.78%-6.14% of baseline real GDP. Interestingly, the estimates of this fiscal shortfall for 2030 are not much higher – 2.77% of baseline real GDP is our central estimate – indicating that the majority of the fiscal changes due to Brexit will occur before the end of the current parliament and over the horizon of the current fiscal charter.

In light of the fiscal charter – delivering a surplus in 2019-20 and remaining in surplus thereafter in ‘normal times’ – and the fact that certain areas of government spending are protected, the Brexit-induced fiscal shortfall will require fiscal adjustment. Given both the size of the estimated fiscal shortfall and recent historical changes in fiscal policy, it is likely that welfare spending will need to fall as part of the policy mix to fill the fiscal shortfall. Such a cut in welfare spending is likely to affect those who rely on tax credit and benefit payments disproportionately.

To quantify the effects on low income households – defined as those in receipt of tax credits or jobseeker’s allowance for the purpose of this study – we calculate their average annual tax credit and benefit receipts. We find that tax credit and benefit payments comprise at least between 29% and 73% of a low income household’s average annual income.

We then combine our estimates of the fiscal shortfall due to Brexit and the average annual tax credit and benefit receipts of low income households. We find that the estimated fiscal shortfall due to Brexit is around 41% (range: 14%-108%) of the projected baseline value of the welfare budget in 2020. The corresponding value for 2030 is 45% (range: 17%-116%). In the worst case, where the government places 100% of the burden of adjustment on welfare spending, we calculate – again, using our central estimate – that low income households could receive between £1,861 and £5,542 per year (in 2014 £) less in tax credit and benefit payments in 2020, and £2,076-£6,184 in 2030.

This result is important because it arises in addition to existing estimates of household income losses due to Brexit. For instance, Dhingra et al. (2016b) calculate that, in the short-run, UK household incomes could be between £850 and £1,700 lower due to the trade and income effects of Brexit. We find, in addition to this, that low income households could stand to lose even more due to reduced tax credit and benefit receipts.

Appendix A – Additional Methods of Projection

Aggregate Projection

We project six fiscal items beyond 2020 using an aggregate growth rule. These six fiscal items are: the climate change levy; interest and dividends; receipts from EU Emissions Trading Scheme auctions; the gross operating surplus; other expenditure; and the net contribution to the EU budget. To form these projections, we assume that aggregate government receipts and expenditure per for these fiscal items grow at an assumed long-run growth rate g . In the event of Brexit, we perturb this quantity g by the growth loss in year t under scenario s , $\hat{g}_{t,s}$. Thus, the aggregate value of fiscal item i in year t (where $t > 2020$) is:

$$T_{t,i} = T_{t-1,i} \cdot (1 + g - \hat{g}_{t,s}) \quad (\text{A.1})$$

We then calculate the distribution of revenue/spending associated with fiscal item i for an individual of age a and gender m by applying equation (1).

Projecting State Pension Spending

We calculate projections for state pension spending in a manner that accounts for planned changes in the state pension age. This means that the projected total pension bill is a function of changes in the population size and structure, as well as changing pension entitlement over time.

Between 2017 and 2020, we project pension spending in the following way. First, we calculate the distribution of pension spending ($i = SP$) in year t by age and gender, $T_{t,SP}^{a,m}$, using

$$T_{t,SP}^{a,m} = T_{t,SP} \cdot f_{SP}^m \cdot s_{t,SP}^{a|m} \quad (\text{A.2})$$

where $T_{t,SP}$ denotes aggregate pension spending in year t , f_{SP}^m denotes the share of pension spending on males, and $s_{t,SP}^{a|m}$ denotes the time-varying share of pension spending on individuals of age a , given their gender m . This latter share is time varying to account for planned changes in the state pension age.²¹ We then use equation (2) to calculate the annual (net) growth rate of the per capita pension spending in year t for individuals of age a and gender m , $g_{t,SP}^{a,m}$. To calculate the projected distribution, under scenario s , of each pension spending by age and gender, for $t = 2017, \dots, 2020$, we use

$$T_{t,SP,s}^{a,m} = \frac{T_{t-1,SP,s}^{a,m}}{N_{t-1,s}^{a,m}} \cdot (1 + g_{t,SP}^{a,m} - \varepsilon_i \Delta g_{t,s}) \cdot N_{t,s}^{a,m} \cdot \mathbf{1}(SPA_t^{a,m}) \quad (\text{A.3})$$

where $\mathbf{1}(SPA_t^{a,m})$ is an indicator variable equal to unit if a person of age a and gender m is entitled to the state pension in year t , and zero otherwise. Finally, we use equation (4) to calculate the aggregate state pension spending in year t under scenario s .

From 2021 onwards, our dataset does not include aggregate projections for pension spending. As with all but six of the fiscal items in our dataset, we project pension spending forward by assuming that its per capita value at each age and gender grow at a constant rate g , which we perturb in the

²¹ That is, it is set to zero for ages that are not entitled to the basic state pension in year t .

event of Brexit. However, we adjust equation (5) to account for planned changes in the state pension age. In particular, we use

$$T_{t,SP,s}^{a,m} = \frac{T_{t-1,SP,s}^{a,m}}{N_{t-1,s}^{a,m}} \cdot (1 + g - \varepsilon_i \Delta g_{t,s}) \cdot N_{t,s}^{a,m} \cdot \Lambda(SPA_t^{a,m}) \quad (\text{A.4})$$

where $\Lambda(SPA_t^{a,m})$ is a time varying indicator variable defined below. We then use equation (4) to calculate the aggregate state pension spending in year t under scenario s .

The indicator variable $\Lambda(SPA_t^{a,m})$ for the post-2020 projection is more nuanced than the indicator variable $\mathbf{1}(SPA_t^{a,m})$ used from 2017 to 2020. In particular, $\Lambda(SPA_t^{a,m})$ can take values other than one or zero. If, in year t , **all** individuals of age a and gender m are entitled to the state pension, $\Lambda(SPA_t^{a,m}) = 1$. If, in year t , **all** individuals of age a and gender m are not entitled to the state pension, $\Lambda(SPA_t^{a,m}) = 0$.²²

However, in some years, the state pension age changes incrementally. For instance, in 2016, not all 63 year olds women are entitled to the state pension. To account for this, we use calculations of the average state pension age in a given year. We define $\Lambda(SPA_t^{a,m})$ in this year by assuming that births are uniformly distributed throughout the year by month. For instance, in 2018, the average state pension age for women is 64 years and 9 months. Thus, we define $\Lambda(SPA_{2020}^{64, \text{female}}) = 4/12$.

²² Therefore, for all a , except the age of retirement, $\Lambda(SPA_t^{a,m}) = \mathbf{1}(SPA_t^{a,m})$.

Appendix B – Tax Credit Conditions 2016-7

In this appendix, we outline the conditionality of tax credit payments for the 2016-7 tax year. The numbers reported here are in 2016 pounds. These are deflated to 2014 pounds in the main body of the paper.

Working Tax Credit

An individual is entitled to working tax credit if either aged 16-24 with a child or qualifying disability, or aged 25 or over with or without children. The individual must work a certain number of hours a week, get paid for their work, and have an income below a certain level.

The basic amount of working tax credit is up to £1960 a year. Additional payments are made according to the following requirements:

- A couple receives up to an extra £2010 a year.
- A single parent receives up to an extra £2010 a year.
- An individual working at least 30 hours a week receives up to an extra £810 a year.
- An individual with a disability receives up to an extra £2970 a year.
- An individual with a severe disability receives up to an extra £1275 a year.
- An individual paying for approved childcare receives up to an extra £122.50 (1 child) or £210 (2 or more children) a week. Note, that due to a lack of data availability, this component of working tax credit is omitted from our calculations.

To be eligible, an individual aged 25-59 must work at least 30 hours a week, a disabled individual must work at least 16 hours a week, a single parent with 1 or more children must work at least 16 hours a week, and a couple with 1 or more children must work at least 24 hours a week between them (with 1 person working at least 16 hours a week).

Child Tax Credit

An individual is entitled to child tax credit if the child they are responsible for is under 16, or under 20 and in approved education or training. The basic amount is £545 a year, with additional elements of:

- Up to £2780 a year for each child.
- Up to £3140 a year for each disabled child (on top of the child element). Note, that due to a lack of data availability, this component of child tax credit is omitted from our calculations.
- Up to £1275 a year for each severely disabled child (on top of the child element and the disabled child element). Note, that due to a lack of data availability, this component of child tax credit is omitted from our calculations.

Child Benefit

Individuals or couples are entitled to child benefit if they are responsible for a child under 16, or a child under 20 and still in approved education or training. Only one person can receive child benefit for a child. There are two child benefit rates:

- £20.70 a week for the eldest child.
- £13.70 a week for each additional child.

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