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Approved By
The European Department

Prepared by Nicolas Arregui, and Jiaqian Chen (both EUR).

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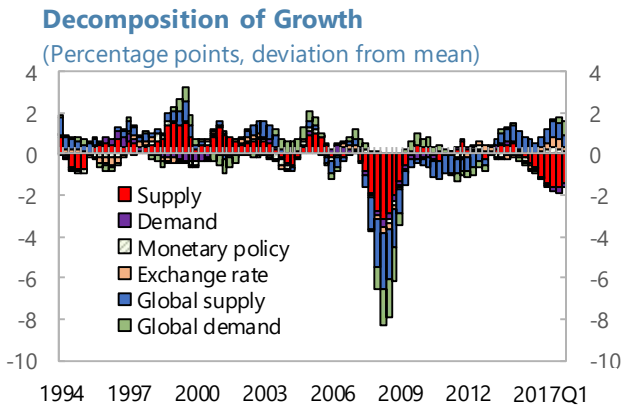
BREXIT: SECTORAL IMPACT AND POLICIES[1]

This paper estimates the long-run economic impact of Brexit on the United Kingdom under two distinct assumptions for the post-Brexit relationship between the United Kingdom and the European Union. These illustrative scenarios entail different degrees of higher trade costs, a more restricted EU migration regime, and reduced foreign inward investment. A standard multi-country and multi-sector computable general equilibrium model is used to quantify the impact of higher trade barriers. The impact from reduced EU migration and inward FDI is based on previous studies. We find that in a scenario representing a typical Free Trade Agreement the level of output is likely to fall by between about 2½ and 4 percent relative to a no-Brexit scenario, with an average of about 3 percent. In a scenario in which the UK and EU trade under WTO rules the level of output is likely to fall by between about 5 and 8 percent relative to a no-Brexit scenario, with an average of about 6 percent. There is substantial sectoral heterogeneity in the impact, and regions with higher concentrations of the more affected sectors are likely to confront greater losses. The empirical analysis suggests the speed of sectoral labor relocation across sectors has been relatively low in the UK. Irrespective of these empirical estimates, policies, such as retraining, would be critical to facilitate faster adjustment of the economy to the post-Brexit equilibrium thereby helping to minimize the associated costs to individuals and in aggregate.

A. Introduction

1. The United Kingdom is in the process of negotiating a framework for the new trading relationship with the European Union. On June 23, 2016, the UK voted to leave the EU and pursue new trading arrangements with the EU and the rest of the world. Two years after the referendum, uncertainty about the shape of the future post-Brexit trade arrangement persists.

2. This uncertainty has already weighed on growth. Business investment since the referendum has been lower than expected in the current growth context (Górnicka, 2018), and consumption remains weak. Net exports have benefited from the sharp sterling depreciation after the referendum while the trading relationship with the EU remains unchanged, offsetting some of the weakness in domestic demand. The growth slowdown also reflects supply side factors including reduced net migration inflow and shallower capital accumulation.



Sources: IMF staff calculations.
Note: Estimated using a structural VAR following Forbes and others (2015).

[1] Prepared by Jiaqian Chen.

3. This paper focuses on the long-run economic impact of Brexit and discusses policies to facilitate the structural transformation implied by the estimated variation in sectoral impacts.

- *What is the long-run economic impact of Brexit?* We first outline two distinct Brexit scenarios (free-trade agreement and WTO) which will form the basis of the analysis. These scenarios are intended to be illustrative and are not predictions of the outcome of the Brexit negotiation; nor are they meant to indicate upper and lower bounds to what could happen. Under each scenario, we quantify the impact from: i) higher trade barriers - using different versions of the computable general equilibrium (CGE) model following Costinot and Rodriguez-Clare (2014); and ii) restricted EU migration and reduced foreign direct investment in the UK - drawing on the relationship between migration and foreign investment and output estimated in the literature. The analysis shares similarities with papers that employ a quantitative trade model to study the impact of Brexit from higher trade barriers, such as Dhingra and others (2017a), Vandenbussche and others (2017), Felbermayr and others (2018), and Latorre and others (2018). Comparing with them, this paper also considers additional channels, including a more restricted migration regime, to give a broader picture of the likely impact of Brexit. Relative to existing empirical studies, such as Fournier and others (2015) and HM Treasury (2016), the advantage of our approach is that it provides a "structural decomposition" of the impact among the different channels, although the range of channels considered here is not complete.[2]

- *What policies can facilitate structural transformation?* The UK labor market is very flexible at the macro level—the ability to maintain a low unemployment rate in the face of macroeconomic shocks. Yet, our empirical analysis suggests the speed of labor relocation from shrinking to expanding sectors, while being faster than most of the European countries in the sample, is slower than the US and the fast-growing economies in Asia. Given Brexit is likely to have heterogenous impacts on different sectors of the economy, we discuss policies that could help to accelerate sectoral reallocation of workers.

4. The estimates suggest that UK's real output would be between 2.6 and 3.9 percent lower under the free-trade agreement scenario than under a scenario of continued EU membership, and between 5.2 and 7.8 percent lower under the WTO scenario than under a no-Brexit scenario. However, there are large uncertainties around each of the estimates which are only partially captured by this range (see ¶35). The uncertainties reflect partly the difficulty of quantifying the non-tariff trade costs as well as the model set up that is most appropriate to capture the structure of the UK economy. Despite these challenges, almost all existing studies, using different methodologies, concluded that Brexit would reduce output in the long run, and the higher the trade barriers the greater the cost.

5. The impact varies significantly across sectors. Sectors that have stronger trade linkages with the EU, confront larger increase in trade barriers and more sensitive to a price change are the ones tend to be more affected. Considering only the trade channel, our analysis suggests, under the

[2] See Paczos (2018) for more discussion on comparing the various approaches to modelling the economic impact of Brexit.

free-trade agreement (FTA) scenario, the average output loss in manufacturing is only about 1 percent. However, losses are estimated to be significantly larger in chemicals, electrical, optical and transport equipment manufacturing sectors. Service sectors face an average loss of about 4 percent, ranging from the relatively unaffected hotel and restaurants sector to a 15 percent loss in financial intermediation. The analysis abstracted from estimating the sectoral impact of a more restricted migration regime as it would require making assumptions on what would the new regime mean for different sectors of the economy. However, sectors, such as food, warehousing, hospitality and agriculture, that employ a significant share of EEA workers, could be more vulnerable to a fall in EEA migrants. And the impact could be larger the faster the decline.

6. Variations in the composition of industries across regions implies some parts of the UK would be more affected than others. For example, financial services account for over 15 percent of London's GVA compared with the national average of about 7 percent. Manufacturing of coke and chemicals account for greater share of GVA in North East, North West and Yorkshire. Moreover, manufacturing firms of transport equipment tend to be concentrated in the West Midlands region. More broadly, services industries account for 80 percent of the output in South East.

7. Policies should work in a coordinated manner to facilitate faster adjustment. Rising trade barriers with the EU are likely to affect some industries more than others, resulting in a reallocation of resource across sectors post-Brexit. Given it takes time for workers to relocate, Brexit could usher a prolonged period of high structural unemployment and/or weak productivity growth. For instance, Barnett and others (2014) suggest about one third of the productivity slowdown in between 2007 and 2011 can be attributed to slower reallocation of resources. Policies should facilitate this adjustment process while limiting the welfare cost to workers who have to move. Product market policies should aim to remove barriers to entry, thereby promote competition. Financial support for entrepreneurship would help workers to upgrade their skills and promote new entrance, thus competition. For labor market, the key is to protect workers not jobs. In particular, active labor marker policies (such as support for retraining) would be critical to facilitate the adjustment for both low-skilled and highly-specialized workers. Reforms to promote housing supply would help workers to move to regions where jobs are.

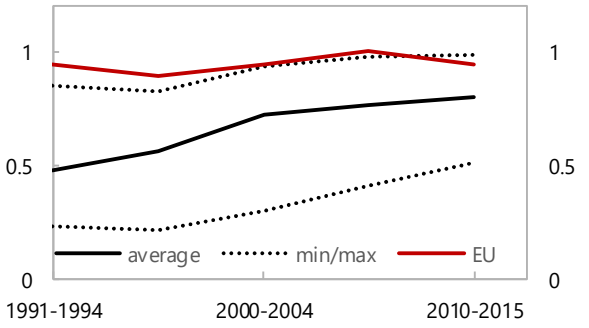
8. Quantifying the impact of Brexit on the UK economy is complex and the estimates are subject to large uncertainty. A key source of uncertainty is the wide range of potential scenarios for the relationship between the UK and the EU after Brexit. Another source of uncertainty is from empirical estimates of trade elasticity and non-tariff trade costs which are important inputs to the model estimates. In addition, there are no similar events in history on which one can draw on. Rodrik (1992) finds that the collapse of the Soviet Union and the Council for Mutual Economic Assistance (CMEA), leading to the disintegration of traditional exports markets in the early 1990s, accounts for all of the 11 percent decline in Hungary's output, about 60 percent of the 19 percent decline in Czechoslovakia's output, and between a quarter and a third of the 20 percent decline in Poland's output in 1990–91. The UK's market-oriented economy differs from central planning approaches of the Eastern European countries at that time, thus any inferences from this episode may be limited.

9. The remainder of the paper is organized as follows. The paper first discusses some of the economic effects of EU membership. Then it gives a brief overview of literature on the impacts of leaving the EU. Section D presents the estimated impact of Brexit. Section E presents some empirical evidence on the speed of sectoral labor reallocation. Finally, we conclude with some policy discussion, focusing on facilitating the transition to the post-Brexit equilibrium.

B. How has EU Membership Affected the UK Economy?

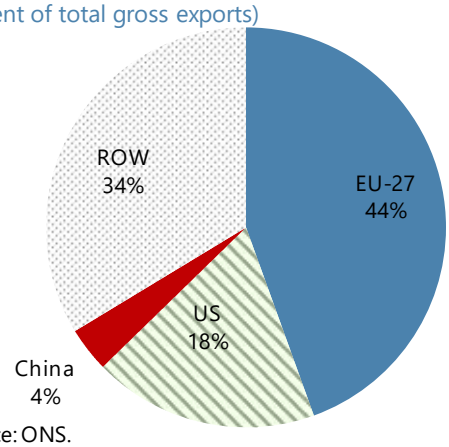
10. EU membership provides access to the European single market and the customs union. The single market is at the heart of the European project and was formalized in the Economic and Monetary Union (1992). With its common regulatory framework and mutual recognition of standards and norms, the it is designed to reduce trade costs (e.g. border inspection) and open up markets to facilitate trade and investment. The depth of integration provided by the single market goes well beyond the tariff reduction - it removes non-tariff trade impediments too. The European customs union is another essential component of the EU. It ensures a common external trade policy, with a common external most favored nation (MFN) tariff schedules, preferential tariffs on goods imports from third countries, and free trade among EU member states. Reflecting these efforts, EU membership provides barrier-free access to the common market.

Depth of Preferential Trade Agreements 1/
(Index, max = 1)



Sources: Hofmann and others (2017), and fund staff calculations.
1/ Depth is measured by the average number of core provisions included in a bilateral preferential trade agreement.

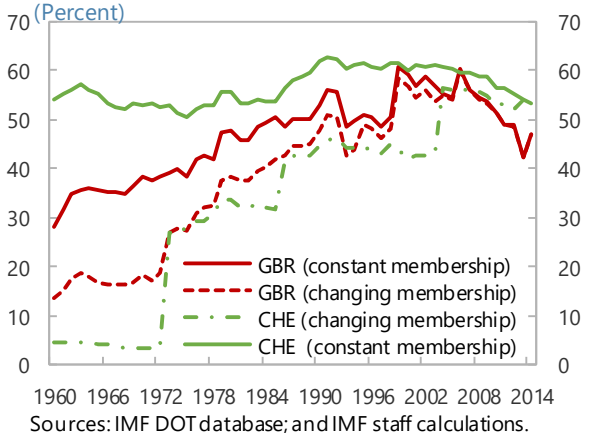
UK: Exports, 2017
(Percent of total gross exports)



Source: ONS.

11. UK trade with the EU has increased steadily since joining the EU. EU27 is UK's largest trading partner: trade (the sum of exports and imports) with EU amounts to about 30 percent of GDP. Exports to the EU accounts for about 45 percent of UK gross exports in 2017. In a meta-analysis, Head and Mayer (2014) show that regional trade agreements lead on average to about 60 percent increase in trade. For the EU, they have a median effect of 26 percent; this is, however, associated with a relatively high standard deviation. Other studies find greater effects. Baier and others (2008) find that EU

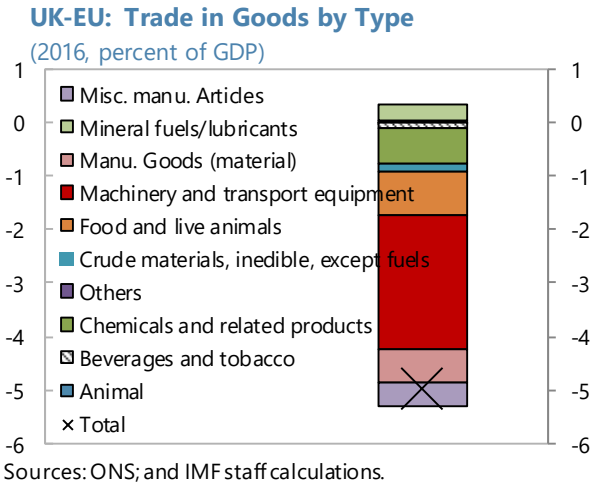
Share of Goods Exports to the EU
(Percent)



Sources: IMF DOT database; and IMF staff calculations.

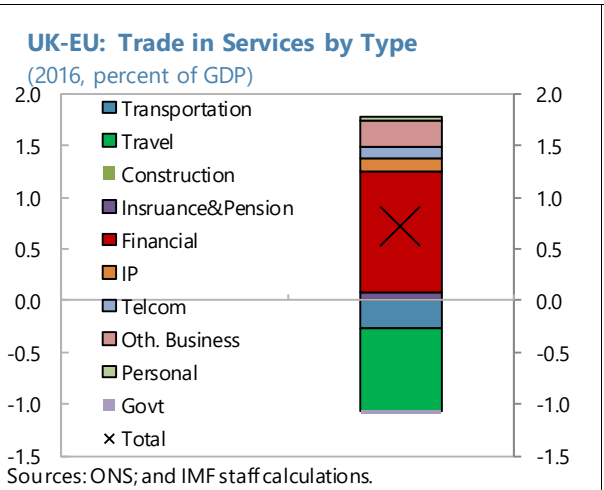
membership increases trade by 92 percent while other regional economic regional agreements increases trade by 58 percent. Mayer and others (2018) find that the single market has had a trade impact more than three times larger than a regular regional trade agreement, increasing trade between EU members by 109 percent, on average, for goods and 58 percent for tradable services and members. Felbermayr and others (2018) find that UK's EU membership has increased goods and services trade by 48 and 84 percent, respectively.

12. The UK runs a deficit in goods trade with the EU, mainly driven by machinery and transportation equipment. UK exported about 9 percent of GDP worth of goods to the EU before the financial crisis. UK goods imports from the EU stand at around 12 percent of GDP, and has been quite steady over the past two decades. Deficits in machinery and transport equipment trade account for over half of the deficit in goods trade.

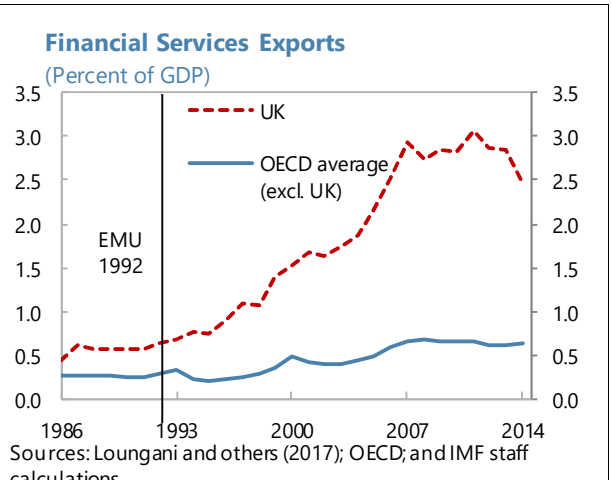


Sources: ONS; and IMF staff calculations.

13. Financial sector accounts for a large share of the surplus in services trade with the EU. The UK financial sector has flourished in the single market with trade in financial services as a percentage of GDP has risen much faster than the OECD average since the inception of the single market. The UK-located banks underwrite around half of the debt and equity issued by EU businesses; they are counterparty to over half of the over-the-counter interest rate derivatives trade by EU companies and banks, and around GBP£1.4 trillion of assets are managed in the UK on behalf of European clients (Box 1).



Sources: ONS; and IMF staff calculations.

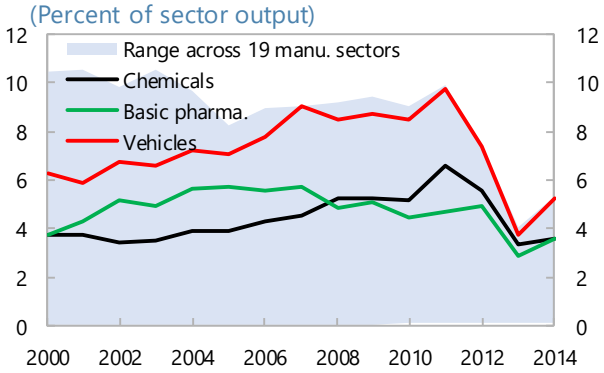


Sources: Loungani and others (2017); OECD; and IMF staff calculations.

14. UK firms are deeply integrated in the European supply chains. Mulabdic and others (2017) find EU membership has increased domestic value added in gross exports of the UK and boosted its integration in global value chains: UK intermediates' value added in gross exports

(forward linkages) increased by 31 percent, while foreign value added in UK exports (backward linkages) increased by 37 percent. As a result, the UK's value chain integration is mainly with the EU where nearly half of the UK's intermediate goods imports and exports are with other EU countries. The EU supply chain also relies on the UK but to a much lesser extent: 10 percent of EU intermediate goods exports and imports are with the UK. UK participation in the international production chain is dominated by the manufacturing sectors (around 60 percent). Participation in supply chains varies significantly across sectors. Transport equipment sector appears to have the most significant reliance on intermediate inputs from the EU (Box 2). This is followed by chemicals, and pharmaceuticals.

Foreign Value Added of UK Gross Exports to EU 27 Across Manufacturing Sectors
(Percent of sector output)



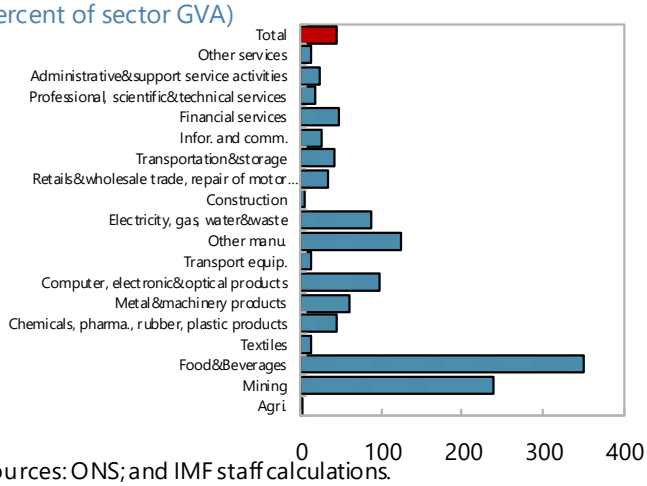
Sources: WIOT; and IMF staff calculations.

15. Quantifying precisely the effects of trade on output and employment is challenging. Free trade improves the allocation of resources by allowing each country to specialize in areas of comparative advantage and benefit from increasing economies of scale. In addition, Bloom and others (2011) argue that trade has generated benefits through greater competition and productivity gains by adoption of leading-edge practices. Moreover, aggregate productivity gains from improved selection and heighted competition have been illustrated in both theoretical frameworks (Eaton and Kortum, 2002 and Melitz, 2003) and empirical studies (Pavcnik, 2002 and Verhoogen, 2008). Yet, to estimating the gains is challenging in part one has to know what would have happened in the absence of EU membership. Existing empirical evidence generally finds that reduced trade barriers due to EU membership have substantially increased UK income (Craft, 2016, and Campos and others, 2014).

16. In addition to the trade advantages, the UK economy has benefited from EU membership in other dimensions:

- *Inward FDI.* The annual value of inward FDI has been between 0.4 to 11 percent of GDP over the past ten years, and a significant share it comes from the EU. Moreover, a significant share of non-EU investors uses the UK as a base to access to the broader EU single market, so this investment may decline as well if access is reduced significantly. Dhingra and others (2017c) estimated that being a member of

Stock of Investment from EU 27 in UK
(Percent of sector GVA)



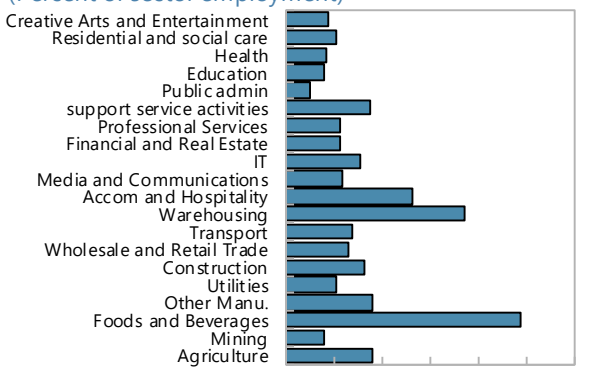
Sources: ONS; and IMF staff calculations.

the EU has increased FDI inflows in the UK by about 28 percent. The higher investment has boosted UK output and wages. Haskel and others (2007) show a significant and positive relationship between inward FDI and productivity in the UK, with a 10 percentage point increase in foreign presence raising productivity by about 0.5 percent. Moreover, foreign investment is unevenly distributed across sectors, with food, mining and manufacturing sectors having large share of foreign investment.

- *Migration*. The number of migrants from the EU has increased over the past decade, and by 2016 EU migrants accounted for about 5 percent of the working age population. The EU migrants have higher employment rates, at about 80 percent in 2017, than the UK-born population. Immigrants from the EU are, on average, more skilled than UK natives, and the educational attainment gap between migrants and natives has been rising over time (Wadsworth, 2015). Empirical analysis suggests migrants have a positive impact on productivity (Boubtane and others 2015). Portes (2015) finds that 50 percent decrease in net migration rate would be associated with a 0.3 percentage point decrease in productivity. The distribution of EU migration across different sectors in the economy is very uneven, with about 25 percent of workers in the food industry coming from the EU, followed by warehousing industry.

Share of EEA Migrants in 2016

(Percent of sector employment)



Source: Migration Advisory Committee.

C. What Does Literature Say About the Impact from Leaving the EU?

17. The majority of empirical assessments indicate that the UK economy would be worse off economically in the long run after leaving the EU, but the range of estimates is large. Most studies conclude that UK would face a permanent net loss in the level of output in the range of 2.2 to 9.5 percent depending on scenarios considered:

- Studies typically assume that the UK would have a more restricted trading arrangement with the EU after Brexit; estimates are more negative in scenarios in which the UK has to rely on WTO rules, as these would involve the largest barriers to trade compared to the existing arrangement with the EU (IMF 2016).

- In addition, several studies, drawing on econometric evidence on the positive relationship between EU membership and trade, assume substantial reductions in labor productivity following exit in addition to the immediate and direct effects of reduced trade. This leads to more significant aggregate losses than focusing just on the trade channel (Dhingra and others, 2017a and HM Treasury, 2016).

18. A few recent studies look into sectoral effects. Typically, the finding is that sectors with larger exposure to the EU would have greater losses post-Brexit. Felbermayr and others (2018) find the impact on manufacturing sectors displays a large variance, with GVA remaining mostly unaffected in food, beverages and tobacco sector and GVA falling by more than 15 percent in chemical and electronics and optical products sectors. For services sector, they find the effects in a WTO scenario are in the range of -3.7 (in sewerage and waste sector) to 2 percent (water transport services sector). The provisional analysis in HM Government (2018) indicates the losses for the manufacturing sectors to be in the range of 6 percent (machinery equipment and energy) to 16 percent (chemical, rubber and plastic products sectors). The variation of the impacts is less stark among the services sectors, with retail and wholesale trade confronted with about 11 percent fall in output, followed by defense, education and health (-8 percent), financial and other services (about -7 percent), and business services (about -6 percent). Using the same class of quantitative trade models, Vandenbussche and others (2017) identify administrative and support activities to be the most affected sector by Brexit.

19. Most of the existing theories point to a level effect, with some suggesting a more restricted trade regime could lead to permanent lower growth rates. In the neoclassical growth model, the equilibrium growth rate is pinned down by an exogeneous technology growth parameter and a time discount factor. In more recent models of endogenous growth, economic integration may affect growth rates by changing incentives to invest in R&D. Empirically, the evidence is also mixed. Studies of the effect of EU membership on the UK economy suggest that there have been permanent increases in the level of output, but do not indicate that there have been permanent changes in potential growth rates from EU membership itself (Craft, 2016).

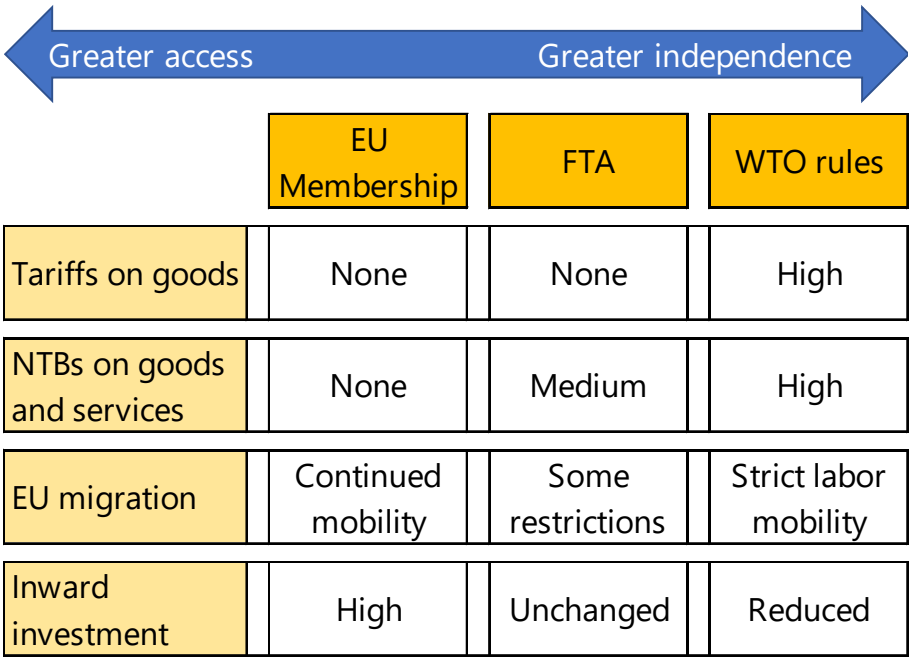
D. Estimating the Impact of Brexit

20. Leaving the EU would affect the economy through different channels, including higher trade barriers, reduced immigration and inward investment. We first focus on the potential impact from higher trade barriers. Then we discuss the potential effects from lower inward migration and foreign investment.

21. We develop two scenarios that reflect a trade-off between greater access and independence. EEA membership is not considered as an option since the UK would have to retain free movement of labor and remain a member of the single market.[3] In the absence of an agreement with the EU, the UK would revert to WTO rules as the basis for trade with the EU. In this scenario (WTO scenario), UK would impose the MFN tariffs on imported goods, and face higher export (both tariffs and non-tariff) costs on goods and services as it would not have access to the single market nor the customs union. Inward investment and inward migration are likely to fall. The other scenario we consider is a free-trade agreement (FTA) scenario, where the UK still leaves the single market and the customs union, but the increase in trade barriers is lower compared with the WTO scenario. As discussed above, the scenarios are intended to be illustrative and are not

[3] See IMF (2016) for a discussion about the long run economic consequences of the EEA scenario.

predictions of the outcome of the Brexit negotiation; nor are they meant to indicate upper and lower bounds to what could happen.



22. In both scenarios, we assume the trading arrangements between UK and other non-EU countries[4] remain unchanged and the UK authorities continue to uphold high regulatory standards. This reflects the difficulties in predicting the type of trade agreements that UK could sign with other countries post-Brexit. In any case, Latorre and others (2018) suggest signing a comprehensive TTIP type of agreement with the US that covers both trade and FDI would only improve the UK GDP by around ½ percent – significantly smaller than the estimated costs from leaving the EU by most of the existing studies. With regard to regulatory standards, UK's product and labor markets are lightly regulated in international comparison. For example, the UK ranks second among European countries for product market liberalization, on par with the US. The UK is the 4th best in OECD rankings of labor market flexibility and has more light employment protection regulation than many other OECD countries such as France, Germany, or Netherlands. Thus, it seems likely that the net impact from changing regulations after leaving the EU could be small (Dhingra and others, 2017a, Oxford Economics, 2016 and Open Europe, 2016). Moreover, the UK government has committed to uphold standards or to exceed the EU minimum requirements in many areas.

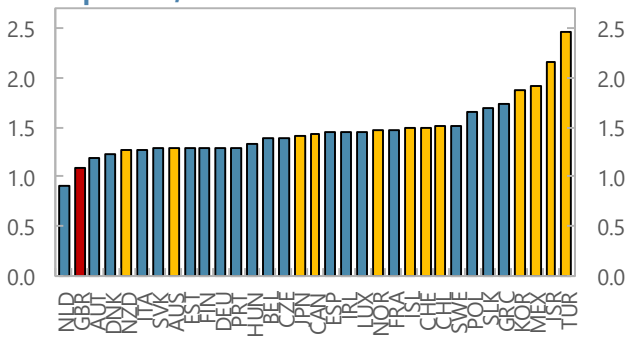
The Trade Channel

23. We rely on a computable general equilibrium trade (CGE) model to explore the long-term effects of Brexit due to higher trade barriers. This class of models features multiple countries, multiple industries and input-output linkages across industries in a Walrasian general equilibrium framework, and it has been the dominant tool for evaluating the impact of trade

[4] Except for Iceland, Liechtenstein, Norway and Switzerland, as they participate in the EU single market.

liberalization since the 1980s. The model estimates changes in real income associated with changes in trade barriers. In the Armington model (1969), there are many countries, each producing distinct goods. Households in each country enjoy consuming a variety of goods, which is possible through international trade. The demand for goods from other countries (i.e., trade flows) is determined by the consumer preferences, income, costs of trade (i.e., tariffs) and price of foreign goods. Market equilibrium conditions imply demand for any good needs to equal to the supply. Hence, when there is a change in trade costs, we solve the model by finding the pattern of income changes that is consistent with the new set of bilateral trade costs, while respecting market clearing conditions. From a single-country perspective, an increase in trade cost decreases the revenues from exports as other countries buy less, reducing income with knock-on effects to other countries, even if trade costs have not changed for these countries. To maintain sustainable external balance over the long run, imports will have to fall too. In the new equilibrium, households are worse off as their income falls and they consume less varieties of goods. The key insight from the Armington model carries into more complex frameworks.

OECD Product Market Regulation Indices Comparison, 2013



Source: OECD.
Notes: Blue color denotes EU countries; yellow color denotes non-EU countries.

24. We use three versions of the CGE models which capture different channels through which trade impacts the economy in the long-term. As in Costinot and Rodriguez-Clare (2013), the first model considers multiple countries and sectors (34 countries plus the rest of the world, and 31 sectors), and includes tradable intermediate inputs for production to capture global supply chain linkages. It assumes perfect competition among the production firms. We then extend the model to incorporate monopolistic competition without firm-level heterogeneity (and fixed exporting costs), like Krugman (1980). Finally, we consider a case of monopolistic competition with firm-level heterogeneity as in Melitz (2003). The latter incorporates the impact of trade on aggregate productivity via (firm) selection effect. For example, higher trade barriers on imports would protect the low productive firms from competition with (more productive) firms abroad resulting a lower aggregate productivity in the domestic economy. The models are used to compare a scenario where the UK remains in the EU with one of the two scenarios in which UK does not. We present the results as a range across the three models, with the average across the three as our baseline estimate.

25. The models draw on data and assumptions from various sources:

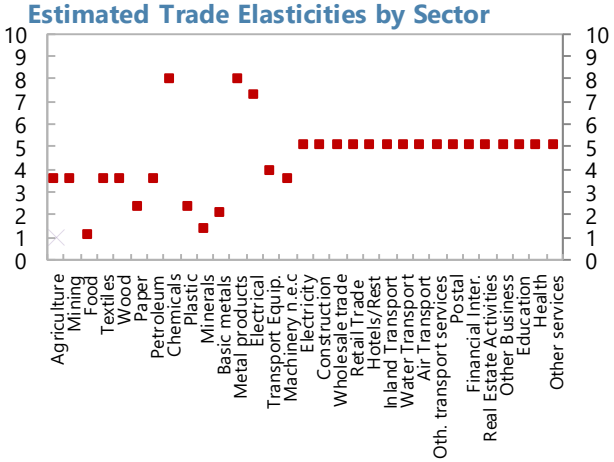
- *Trade linkage data* are based on the World Input-Output Database (WIOD) for the year 2011. We aggregate the data into 34 countries and the rest of the world, and 31 sectors. The database is similar to the trade data published by the ONS.

- *Trade elasticities* govern the responsiveness of trade flows to changes in trade costs. For goods, we use the estimates from Felbermayr and others (2018) as their estimation procedure is consistent with quantitative trade models with sector-level gravity equations, while trade elasticity for services sectors is held constant at 5 following Costinot and Rodriguez-Clare (2013).

- Data *on bilateral preferential and most favored nation (MFN) tariffs* are taken from World Integrated Trade Solutions and the WTO's Integrated Database.

- *Non-tariff trade barriers (NTBs)* are related to costs of differences in product regulations, legal barriers, and other transaction costs for both goods and services—several authors point out that such costs are higher than formal tariffs (Anderson and van Wincoop, 2004). There is an extensive literature on the use of empirical gravity models to estimate NTBs (Novy, 2013; Felbermayr and others, 2018; Egger and others, 2015; Berden and others, 2009; Abbyad and Herman, 2017). Gravity models have the advantage of being able to robustly quantify barriers to trade that are difficult to quantify with other approaches. We use the same source (Felbermayr and others, 2018) for the NTB estimates as the trade elasticities to ensure consistency.

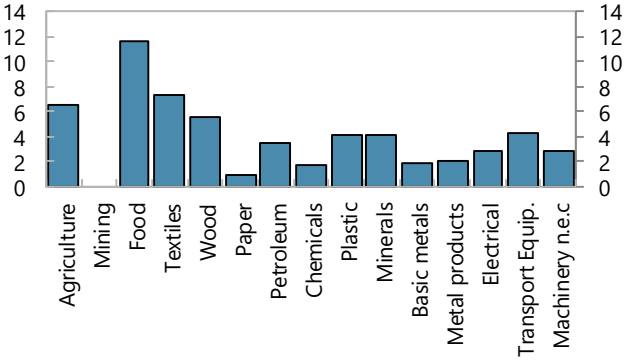
Estimated Trade Elasticities by Sector



Sources: Felbermayr and others (2018); and IMF staff calculations.

Average MFN Tariffs on Intra-EU Trade in 2014 1/

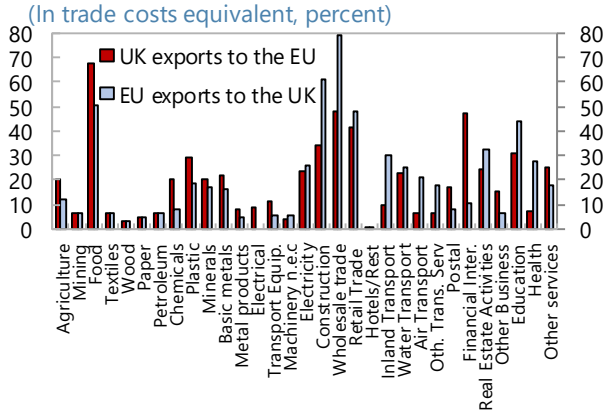
(Percent)



Sources: Felbermayr and others (2018); and IMF staff calculations.
1/ Averages of sectoral bilateral tariffs across intra-EU country-pa
Sectoral bilateral tariffs are trade-weighed MFN averages of the product-level MFN tariffs imposed by the EU in 2014.

Estimated NTBs by Sector

(In trade costs equivalent, percent)



Sources: Felbermayr and others (2018); and IMF staff calculations.

26. The scenarios consider an increase in tariffs and non-tariff barriers for both goods and services trade. More specifically:

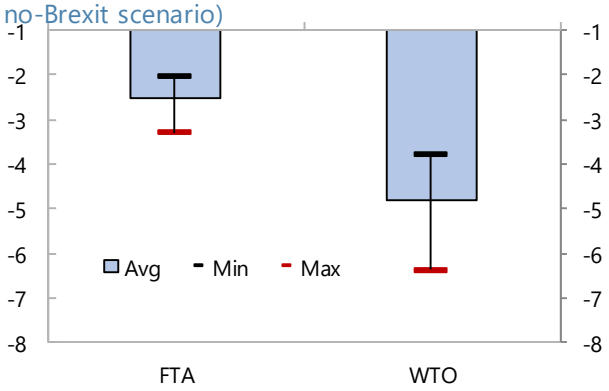
- *FTA Scenario* assumes that tariffs on goods remain at zero, while non-tariff costs rise to half of the estimated non-tariff trade costs that have been eliminated due to UK's EU membership (Felbermayr and others, 2018). In numerical terms,

this is equivalent to about 10 percent, on average, increase in tariff-equivalent non-tariff trade costs for all sectors.

- *WTO Scenario* assumes the UK and the EU would apply the MFN tariffs on goods trade with each other. In addition, it is assumed that non-tariff trade costs will rise by the full amount of the estimated non-tariff trade costs that have been reduced due to UK's EU membership, equivalent to an average of 20 percent increase in tariff-equivalent non-tariff trade costs for goods and services sectors.

27. As a result of the higher trade barriers, UK output falls by 2.5 and 4.8 percent, on average, in the FTA and WTO scenarios, respectively. More specifically, output in the UK could experience a loss between 3.3 (with Melitz set-up) and about 2 percent (with Krugman or perfect competition) in the FTA scenario. If the UK trades with the EU on WTO terms, output loss increases significantly to 6.4 percent (with Melitz), 4.2 percent (with Krugman) and 3.8 percent (with perfect competition). It is intuitive that estimates from the model with Melitz setup show the largest impact reflecting the additional channel on productivity from higher trade barriers. Given all three versions of the model have been used in the literature to estimate the Brexit impact, we take the average of the estimated effects as the baseline.

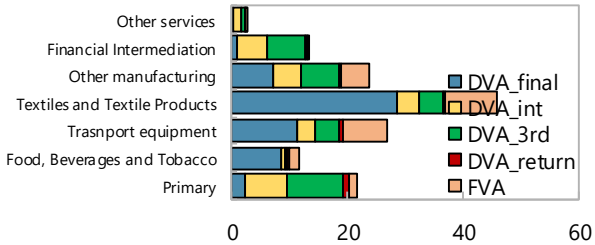
Estimated Brexit Impact from Higher Trade Barriers on Real GDP (Percent deviation from no-Brexit scenario)



Source: IMF staff calculations.

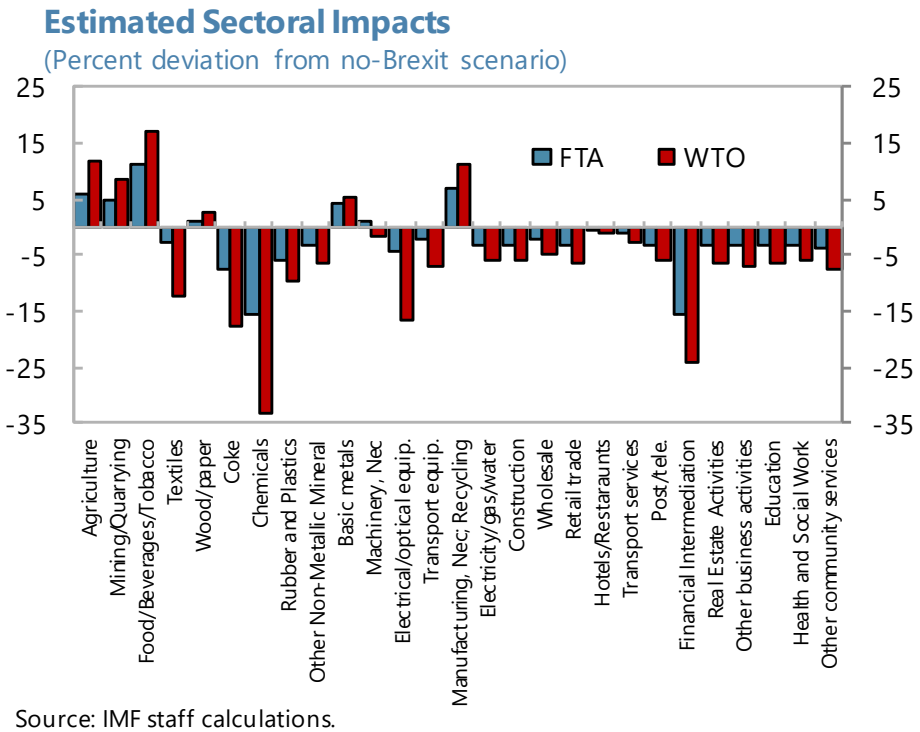
28. The effects vary significantly across sectors. Output in agriculture, natural resource and food manufacturing sectors is expected to improve, broadly consistent with the findings in Dhingra and others (2017b), HM Government (2018), Felbermayr and others (2018) and Levell and Keiller (2018). This could reflect the fact that demand for these goods is less price sensitive, so domestic consumers switch from imports towards domestically produced goods, thereby benefiting production of domestic firms. In particular, there will be a greater share of low productive firms operating in the domestic economy (in the model with Melitz set up), pulling down aggregate productivity. Some manufacturing sectors are confronted with significant decrease in output, with chemicals sector expected to see the largest fall. Other manufacturing sectors with large domestic value added in its exports to the E.U., such as transport equipment (see Box 2) and textiles could also see significant

UK: Gross Exports to EU27 by Selected Sectors
(Percent of sector gross output, 2011)



Source: World Input-Ouput Tables; and IMF staff calculations.
Note: DVA_final stands for domestic value added of exports of final goods/ services to EU27. DVA_int depicts domestic value added of exports of intermediate goods/services and consumed in EU27. DVA_3rd depicts domestic value added of exports to EU27 then re-exported to a 3rd country. FVA depicts the foreign value added. The decomposition is based on Wang and others (2013).

losses in output in the WTO scenario. The average effect for the services sectors is more negative. It ranges from the unaffected hotel and restaurants sector to a about 25 percent reduction in financial intermediation output in the WTO scenario. In the FTA scenario, the average loss across all sectors is smaller, reflecting a lower increase in trade barriers.



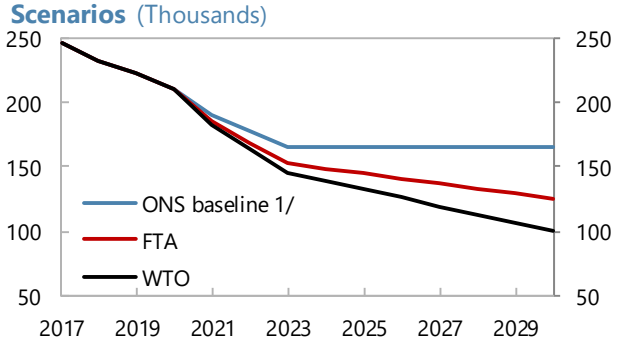
Source: IMF staff calculations.

29. Financial intermediation is among the most affected sectors. This in part reflects the importance of EU business to the UK's financial sector: Oliver Wyman (2016) suggests about 25 percent of annual financial services revenues in the UK is related to business with the EU and Bruegel (2017) estimates about 35 percent of London wholesale banking is related to EU27 clients (equivalent to about 17 percent of all UK banking assets). However, it should be noted that the impact on the financial sector goes far beyond the direct effects. Our estimates incorporate the so called "knock-on" impact on the whole financial system that resulted from the loss in the UK of activities that operate alongside those parts of business that leave, the shift of entire business units, or the closure of lines of business due to increased costs. For example, an activity that needs to operate adjacent to another linked activity may have to relocate if the activity it collocated with were to leave the UK as a result of its exit from the EU. This channel is particularly relevant in the UK given the high level of interconnectedness of the financial system. Oliver Wyman (2016) estimated this broader impact on the financial system is just as large as the direct impact. Furthermore, the model estimates incorporate the general equilibrium effects from lower aggregate demand. It should be noted, however, that the impact of non-tariff barriers is also more uncertain in financial services. For example, financial sector firms will have to set up new entities and relocate staff in order to provide certain services in the EU, which will have a heterogenous cost impact across different firms, due to different client bases and business models. In the medium term, future harmonization across the EU could alter the national licensing regimes making potential NTBs uncertain. (Box 1)

Migration

30. A substantial reduction in EU migrants would reduce potential output further. Following the provisional HM Government (2018) analysis, we assume the government adopts a model that imposes preferential lower minimum income requirement (equivalent to GB£20,500 salary threshold) for EU migrants relative to the non-EU migrants in the FTA scenario. The new regime is assumed to be phased in gradually over time, resulting in a smooth fall of net migration relative to the ONS baseline population projection, reaching a difference in annual net migration inflows of 40,000 people per year in 2030. A more restricted regime is assumed in the WTO scenario, resulting in net migration falling to 100,000 in 2030, i.e. about 40 percent below the ONS baseline projection.

Projections of Net Migration under Different Scenarios (Thousands)



Sources: EU Exit Analysis Cross Whitehall Briefing (HMG, 2018); ONS and; IMF staff calculations.
1/ ONS National Population Projections: 2016-based projection.

31. A reduction in migrations reduces the labor force. Moreover, empirical evidence reveals a strong link between migration and productivity in the long-run. Theoretically, migration enhances productivity by increasing competition in labor and product markets and by facilitating the growth of high-productivity clusters. Following Portes and Forte (2017), we draw on two papers: Boubtane and others (2015) find that migration in general boosts productivity in advanced economies, but by varying degree. For the UK, a 1 percentage point increase in the migrant share of working age population leads to a 0.4–0.5 percent increase in productivity. This is higher than for most other advanced economies, reflecting relatively high skilled migration to the UK. Jaumotte and others (2016) find that a 1 percent increase in the migrant share in the adult population results in an increase in GDP per capita and productivity of about 2 percent.

32. The projected fall in EU migration reduces output by 0.6 and 1 percent in 2030 under the FTA and the WTO scenarios, respectively, and per capita GDP declines as well. The size of the UK adult population is projected to be about 55 million in 2030 under the ONS baseline population projection. The vast majority of EU migrants to the UK are working age, thus a cumulative reduction in migration of 220,000 by 2030 reduces the total adult population and the share of migrant in the labor force by 0.3 percent and 0.3 percentage points, respectively, in the FTA scenario. Using the average elasticities between the two estimates discussed in the previous paragraph, this would reduce GDP per capita by about 0.4 percent and GDP by 0.6 percent in the FTA scenario. In the WTO scenario, GDP per capita falls by about 0.7 percent and GDP by 1 percent.

Inward Investment

33. After leaving the EU, FDI into the UK is likely fall. The literature suggests UK's inward FDI increased by about 28 percent owing to its membership to the EU (see Bruno and others, 2016,

Campos and Coricelli, 2015, and Straathof and others, 2008). Leaving the EU could lead to a fall in FDI as the higher trade barriers would mean more expensive to export to the EU. Moreover, multinationals with complex supply chains might reallocate their operations from the UK to the EU avoid an increase in trade costs, difficulties with intra-firm staff transfers, and costs arising from different regulatory standards. We do not assume any reductions in FDI in the FTA scenario. However, in the WTO scenario, we assume inward FDI falls by about 5 percent compared to the pre-Brexit WEO projection and the decline lasts for a period of 5 years (equivalent to a reversal of about 20 percent of the increase in FDI inflows attributable to EU membership).[5]

34. In the WTO scenario, the assumed reduction in inward FDI depresses output by 0.4 percent. FDI brings direct benefits as foreign firms are typically more productive and pay higher wages than domestic ones. Indirectly, FDI brings new technological and managerial know-how that can be adopted by domestic firms, often through multinational supply chains (Harrison and Rodriguez-Clare, 2010). FDI can also increase competitive pressure, encouraging managers to improve their performance. Consistent with this, a reduction in FDI is likely to reverse these benefits. We draw on the literature for estimated elasticities of FDI on output. For example, Alfaro and others (2004) find a positive empirical relationship between increase in FDI and GDP. The link is especially strong for countries like the UK that have a highly developed financial sector. Using their elasticities, the fall in FDI reduces output (real income) by about 0.4 percent under the WTO scenario.[6]

Results

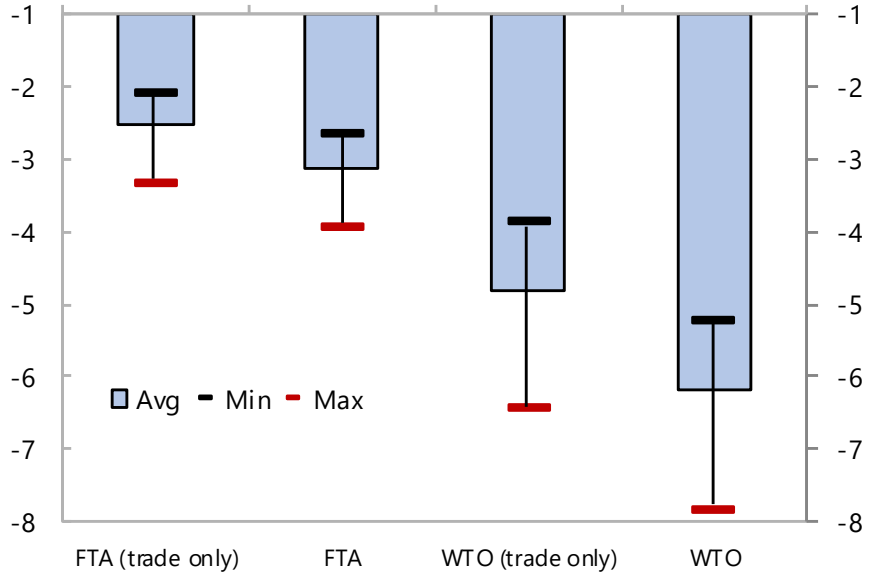
35. Incorporating the potential effects from higher trade barriers, lower migration and reduced inward investment, output falls by between 5.2 and 7.8 percent in the WTO scenario, with an average of 6.2 percent, and by between 2.6 and 3.9 percent, with an average of 3.1 percent, in the FTA scenario—in line with existing studies. Studies which focus only on the direct trade impacts (Dhingra and others, 2017a; Felbermayr and others, 2018 and Vandebussche and others, 2017) tend to show relatively small effects compared with other studies in the literature. Our estimated impacts from the trade channel alone are slightly larger than Dhingra and others (2017a) and Felbermayr and others (2018), partly because we consider models with monopolistic competition rather than perfect competition setup, and greater than Vandebussche and others (2017) in part owing to the size of assumed non-tariff trade barriers. Studies that explicitly account for the productivity effects tend to find larger impacts. Kierzenkowski and others (2016), HM Treasury (2016) and Ebell and Warren (2016) appeal to evidence on the impact of trade openness on productivity as a basis for inputting direct reductions in productivity into the model (NIESR NiGEM). For example, Ebell and Warren (2016), in their WTO+ scenario, assumed an elasticity

[5] We made a very conservative assumption on the potential reduction of FDI in both scenarios for two main reasons. First, the impact on FDI from leaving the EU could be different compared with joining. Second, some of the impact of a reduction in FDI could have been already captured by the estimates from the trade model. For example, if higher trade barriers lead to a reduction in output by foreign companies producing in the UK, then the fall in output should coincide with a recution in FDI inflows to the UK.

[6] To calibrate the growth affect, we assume FDI inflow as share of GDP of 2.4 percent. The proxy for financial market development in Alfaro and others (2004) is the share of private sector credit in GDP. This takes a value of 46 percent of GDP in the UK in their data from Levine and others (2000).

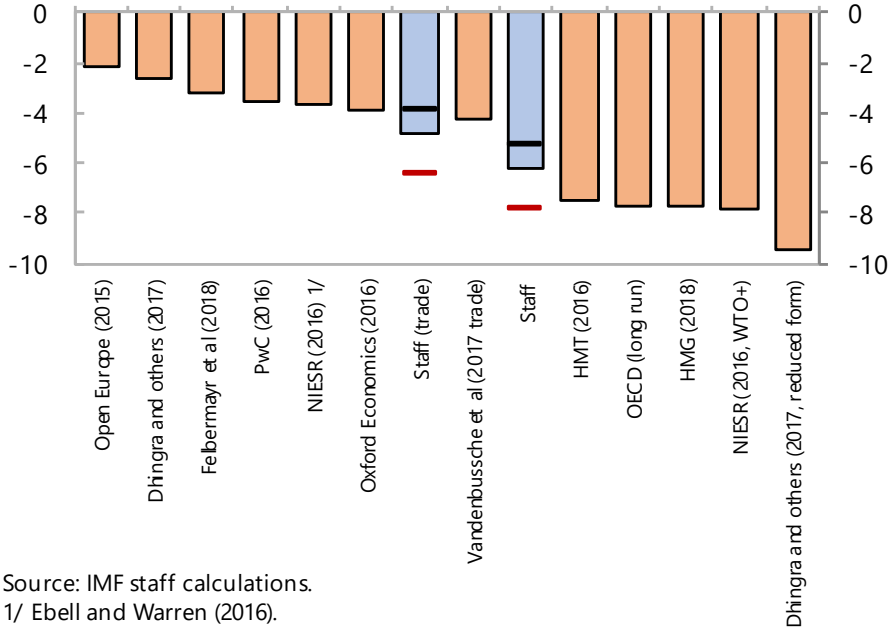
of 0.25, suggesting the 20 percent decline in trade as in their WTO scenario reduces GDP by 5.1 percent through lower productivity. Finally, studies that based on estimating empirical models (such as Dhingra and others, 2017a) point large impact of Brexit as the reduced form estimates capture broader channels of Brexit.

Estimated Brexit Impact on Output
(Percent deviation from no-Brexit scenario)



Source: IMF staff calculations.

Comparison with External Studies of Estimated Brexit Impact in WTO Scenario (Percent deviation from no-Brexit scenario)



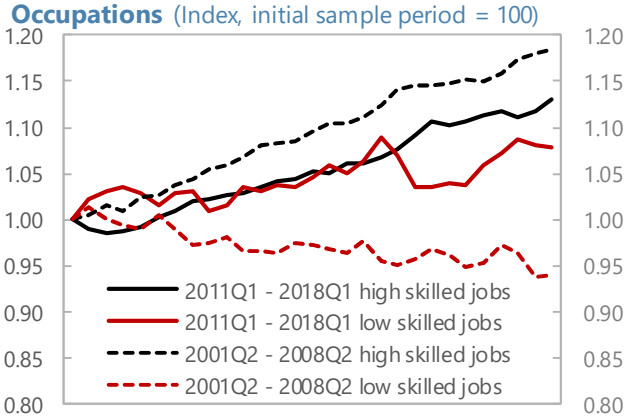
Source: IMF staff calculations.
1/ Ebell and Warren (2016).

E. Sectoral Labor Reallocation

36. Discussion about labor market flexibility can be broadly organized around two concepts: micro and macro flexibility (Blanchard and others, 2013). The former refers to the ability to allow for the reallocation of worker into jobs needed to sustain growth; and the latter corresponds to the ability of the economy to adjust to macroeconomic shocks. We focus our discussion around the micro flexibility.

37. Some workers would need to reallocate from more to less affected sectors after Brexit. Labor market flexibility at the macro level does not necessarily imply speedy flows of workers from low-productivity to high-productivity firms. Indeed, there can be barriers to a rapid relocation. These include excessive product market regulations that deters competition, limited access to credit that makes difficult for new firms to enter, and highly specialized sector-specific human capital that makes those workers difficult and unwilling to change sectors. Empirical evidence supports the importance of industry level skills where workers can transfer skills acquired in one firm to another in the same sector, while on the other hand, they suffer wage losses by changing industry (see Neal, 1995 and Haynes and others, 2000). These rigidities may result in inefficient allocation of employment shares which in turn could weigh on productivity growth. Although UK ranks highly in terms of labor and product market regulations, low human capital[7] or highly specialized skills can deter workers from taking on jobs in other sectors. Greenaway and others (2000) documented gross job-to-job flows are procyclical in the UK and many of these flows are not occurring from the declining to the expanding sectors: over the period of 1975–1995, about 6 to 11 percent of individuals change firms each year, only 2–3 percent switch from the declining to expanding sector. In recent years, there has been more jobs created in low-skill sectors (per job in high-skill sectors) relative to 2001–2008.

Employment in Low and High Skilled Occupations (Index, initial sample period = 100)



Sources: Eurostat; and IMF staff calculations.

38. In this section, we empirically estimate the speed of labor reallocation, and assess the role of policies in facilitating this process. Following ElFayoumi and others (2018), we estimate a dynamic panel error correction model of sectoral labor allocation using sector level data for a panel of 14 high-income economies. In the model, sectoral gross valued added and employment shares are driven by the same underlying process of technical change (Herrendorf and others, 2013 and Ngai and Pissarides, 2007). At the same time, policy distortions or institution costs can constrain the "adjustment speed" of labor across sectors (Pagan, 1985 and Alogoskoufis and Smith, 1991). These

[7] UK students rank low on tests of basic numeracy and literacy despite relatively high average education spending in percent of GDP as well as per pupil.

distortions cause short-term gaps in labor productivity across sectors by slowing down the efficient adjustment of employment shares in response to changes in sectoral labor productivity.

Empirical Strategy

39. Model Specification. Following Ngai and Pissarides (2007), labor allocation across sectors is governed by a long-run equilibrium relationship where labor (*N*) is allocated to sectors according to relative sectoral consumption expenditure $c * p$ (or gross output in equilibrium). Then following Pagan (1985) and Alogoskoufis and Smith (1991), the ECM model can be interpreted as the optimal adjustment rule of an economy that faces a penalty for both deviations from equilibrium as well as rapid adjustments. In this case, $N_{i,j,t}$ (employment in sector i, country j and time t) tracks the equilibrium value $N^*_{i,j,t}$ but with lags following deviations that occur in the short term. Taking the simple case of minimization of a myopic quadratic cost function,

$$\Lambda_{i,j,t} = 1/2\left(N_{i,j,t} - N^*_{i,j,t}\right)^2 + \kappa/2\Delta N^2_{i,j,t}$$

where κ is the ratio of the marginal cost of adjustment relative to the marginal cost of being away from equilibrium. The optimal allocation of labor at time t would have the following solution:

$$\Delta N_{i,j,t} = \lambda\left(N^*_{i,j,t} - N_{i,j,t}\right) = \Delta N^*_{i,j,t} - \lambda\left(N_{i,j,t-1} - N^*_{i,j,t-1}\right)$$

where $\lambda = \frac{1}{1+\kappa}$ is the speed of adjustment parameter, which lies between 0 and 1: the closer λ is to 1 the faster the speed of adjustment.

In the long-run equilibrium sector employment is a function of price (P_i) and real output (VA_i) (Ngai and Pissarides, 2007) that is: $N^*_{i,j,t} = f(P_i * VA_i)$, our baseline model is specified as below:

Long run:

$$\log(N_{i,j,t}) = \delta_1 \log(VA_{i,j,t}) + \delta_2 \log(P_{i,j,t}) + \delta_3 \boldsymbol{X} + e_{i,j,t} \quad (1)$$

Short run:

$$\Delta\log(N_{i,t}) = \beta_1 \Delta\log(VA_{i,t}) + \beta_1 \Delta\log(P_{i,t}) - \lambda\left[e_{i,t}\right] + \beta_3 Z_{it} + u_{i,t} \quad (2)$$

where $\beta_1$and β_2 are short-term elasticities, λ is the adjustment speed, and δ_1 and δ_2 correspond to the long-term elasticities. $\boldsymbol{X}$ includes constant and linear trend fixed effects (sector x country). Z_{jt} includes an index for the global business cycle and a global linear trend.

40. Estimation. We estimate equations (1) and (2) in two stages. In the first stage, we estimate the stationary error term as well as the long run elasticities from the co-integration relationship in equation (1) using pooled OLS. In the second stage, we construct the error term using estimated long-term elasticities from equation (1). Then we estimate equation (2): the short-term elasticities as well as the adjustment speed parameter using fixed effect panel regression (sector and time) on a country-by-country basis. Doing so allows us to produce country-specific adjustment speed parameter λ.

41. The data is compiled from the Groningen Growth and Development Center 10 sectors (GGDC) database (Timmer and others, 2015). It contains information on employment and value-added shares across sectors from 1960–2012 for 14 high-income countries, and 10 sectors. The country and sector coverage has been limited by data availability. However, we control for country and sector specific characteristics by including country and sector level fixed effects in the econometric analysis.

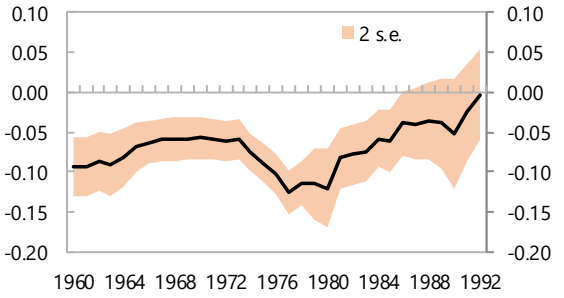
Results

42. The results of the baseline model are reported in Table 1. The variable of main interest is the estimated value of the adjustment speed (i.e. the coefficient on the ECM term, λ). The estimated average adjustment speed is -0.17 across the 14 high-income economies in our full sample. The negative sign reflects a convergence pattern, while the magnitude of the speed implies that the average economy in our sample reallocates about 17 percent of the distance between its current and desired long run allocation within one year.

Text Table 1: Labor Reallocation

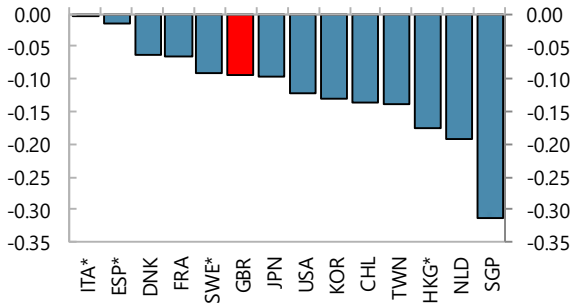
Dependent variable:	Growth in relative labor share	
Sample:	14 high-inc. economies	UK
ecm term (speed of adj.)	-0.17***	-0.09***
	(0.03)	(0.02)
Relative GVA growth	0.07***	0.04
	(0.02)	(0.04)
Relative sectoral price growth	0.05**	0.12***
	(0.02)	(0.03)
sector dummy	Yes	Yes
Observations	5,306	441
R-squared	0.08	0.14

Estimated Speed of Adjustment 1/



Sources: IMF staff calcutlaions.
1/ The chart depicts the estimated coeficient of the ecm term in equation 2 with rolling sample starting points. The end point of the sample is fixed at 2012.

Estimated Speed of Labor Reallocation Over a Set of High-income Economies

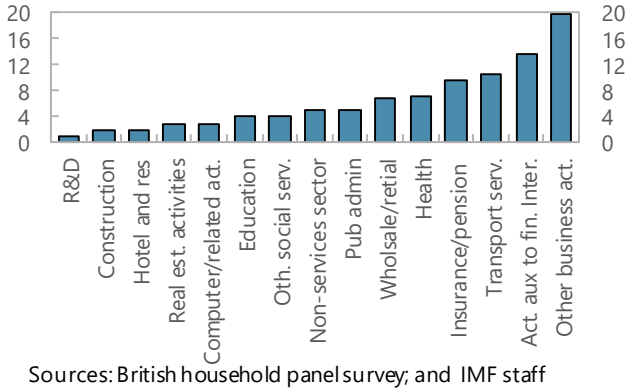


Sources: IMF staff calculations.
Note: Asterisk denotes the esimated coefficient is not statistically significant.

43. The estimated UK-specific speed of adjustment parameter is lower than the US and fast growing economies in Asia, while faster than most of the European countries in the sample. Comparing across the estimates for the 14 high-income economies, the estimated λ for UK is positioned in the middle. On one end of the spectrum, Singapore enjoys the most dynamic labor force, allowing it to close productivity gaps across sectors with the fastest rate (27 percent a year). However, the speed drops to just 1 percent for countries like Italy and Spain where the estimated coefficients are not statistically significant. Moreover, the estimated speed of adjustment appears to

be relatively stable in the UK until the late-1980s. The low rate of sectoral labor reallocation in the UK seems to be counter-intuitive at the first instance, as the UK's labor market is perceived as very flexible (i.e. the unemployment rate has fallen to historical lows). However, for example, high sector specific skills may provide strong incentives for workers to stay within the same industry. For example, historically, 50 percent of the people worked in the financial sector found their next job in financial services related sectors.

Which Sector do Workers go after a working in the Financial Sector (Percent)



Sources: British household panel survey; and IMF staff calculations.

44. These empirical estimates should be interpreated with caution, given the important uncertainty characterizing the empirical estimations. Despite its technical appeal, the econometric estimations remain subject to statistical uncertainty. Furthermore, there are two important limitations to the current exercise. First, the sample of high-income economies has been constrained by the availability of long time series which is critical to identify impact of structural changes. Second, the UK labor market has gone through some important reforms in recent years, thus the empirical results may not fully reflect the effectiveness of these reforms.

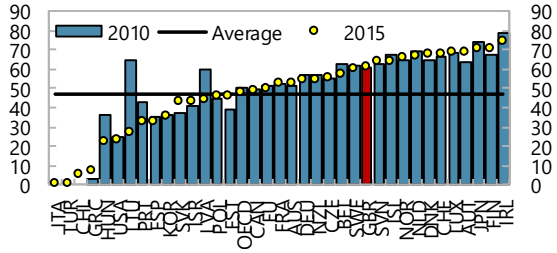
F. Policy Discussion

45. Policies have a key role in facilitating faster adjustment and minimize the associated costs to individuals and in aggregate. For product markets, competition is the key force behind reallocation. UK already has one of the least restricted product market (Koske and others, 2013). Making finance available to support for entrepreneurship would can also help workers to upgrade their skills and promote new entrance, thus competition. For labor market, the key is to protect workers not jobs. Reforms to promote housing supply would help workers to move to regions where jobs are. More specifically:

Labor Market Policies

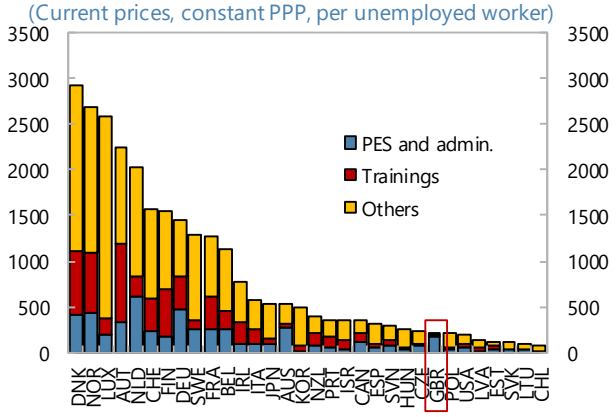
46. The existing relatively generous long-term unemployment benefit should be coupled with effective active labor market policies. In the UK, unemployment benefit (measured by net income replacement rate) is below the OECD average; however, long-term unemployment benefit is above. Although there is a need for government to provide such insurance as workers cannot fully self-insure against unemployment risk, it has long been recognized that provision of insurance may come at the cost of efficiency. However, high quality of active labor market policies aimed to helping workers return to work can mitigate the efficiency losses from high unemployment benefit. For instance, the Nordic model tends to offer very generous benefits for unemployed workers, but these are coupled with effective labor market policies.

60th Month Net Income Replacement Rates for Unemployment (Net income when unemployed as a percentage of net income when working)



Sources: OECD; and IMF staff calculations.
1/ After tax and including unemployment benefits, social assistance, family and housing benefits in the 60th month of benefit receipt. Values for Turkey are equal to zero in 2010 and 2015 and for Italy in 2015.

Expenditure in Active Labor Market Measures
(Current prices, constant PPP, per unemployed worker)



Sources: OECD; and IMF staff calculations.

47. Expenditure on labor market training in the UK is among the lowest in the OECD. Well-targeted spending on training for unemployed workers could help to address skill deficiencies and facilitate the transition into a job in more productive industries, which would in turn have potential positive impacts on wages and job stability. Lack of training could explain why the UK ranks lower than other high-income economies in relocating workers from shrinking to growing sectors. Recently, the Chancellor has announced a package of measures to support business to boost skills and growth, including, as part of the National Retraining scheme, a new career guidance service that will offer expert advice to help people to identify work opportunities and get the skills to secure the job.

48. Although evaluations of active labor market programs show a mixed track record, programs that develop specific skills tend to produce positive employment effects over the medium term. The literature finds positive employment effect from training programs that are designed to target at specific skills (see Box 3). Efficient allocation of funds could be achieved by allowing public employment providers to choose which training program should unemployed workers participate in. Last but not the least, the government should provide clear guidance on job opportunities in the future based on the observed effects from Brexit.

Other Policies

49. Policies support entrepreneurship would help workers to upgrade skills and promote competition. In addition to government supported training programs, access to credit to finance further education, self-employment, or entrepreneurship will be essential for those workers willing to change their careers most significantly. For example, the New Entrepreneur Scholarships program has shown to have helped potential entrepreneurs with financial resources to set up new businesses (Slack, 2005). Re-training programs, such as U.S. Trade Adjustment Assistance (D'Amico and Schochet, 2012) and the European Globalization Adjustment Fund (EGF) have been found to improve re-employment probabilities and earnings, although the program deployments were more likely the more visible the layoffs and the higher the workers' awareness of the existence of the programs. As the UK exits from the EGF and from the European Social Fund and plans for the UK

Shared Prosperity Fund as replacement progress, developing trade adjustment programs that are visible and fairly applied (Claeys and Sapir 2018) could be considered.

50. Efforts to continue boost housing supply would help workers to relocate to regions where jobs are. There is consensus around the UK housing supply is lagging demand: in 2016/17, the total housing stock increased by around 217,000 residential dwelling, 15 percent higher than the previous year's increase but short of the estimated 240–250,000 new homes needed to keep pace with household formation. Further accounting for the backlog of housing needs, the House of Lords Select Committee on Economic Affairs (Building more homes, 2016) recommended the development of at least 300,000 new homes annually for the foreseeable future. Empirical analysis provides strong evidence of house prices (and regulations) have a significant impact on regional migration in the UK (see IMF, 2017). This suggests easing housing supply constraints and making houses more affordable is critical to allow workers relocate to regions where jobs are. The government has pledged to delivery 1 million homes by the end of 2020 and to deliver half a million more by the end of 2022. The recently published Housing White paper has identified threefold problems (not enough local authorities planning for homes they need, housebuilding that is simply too slow, and a construction industry that is too reliant on a small number of big players) that are holding back housing supply. Efforts should continue to further boost housing supply, including by easing planning restrictions, mobilizing unused publicly-owned lands for construction, and providing incentives for local authorities to facilitate residential development[8] (Wilson and Barton, 2018 and Andrews and others, 2011).

G. Conclusions

51. This paper estimates the long-run economic consequences of Brexit under various post-Brexit scenarios. The results are broadly in line with recent findings in the literature and indicate an output loss of between about 5 and 8 percent in the WTO scenario compared with a no-Brexit scenario. In the more benign FTA scenario, output falls by between about 2½ and 4 percent relative to continued EU membership in the long run. There is significant cross-sector heterogeneity in the effects.

52. Policies have a critical role to facilitate the structural transformation after Brexit. Greater emphasis on active labor market programs, such as retraining, and improving the quality of education more generally will help facilitate labor reallocation and support productivity. Making credit available to encourage entrepreneurship would help workers to upgrade their skills and mobility, thereby, allowing workers to move to where jobs are.

[8] For example, the National Housing Federation (in their submission to the Autumn Budget 2017) has set out some measures that would improve house building by the local authorities, including additional government investment.

Box 1. The Financial Sector[1]

The financial services industry constitutes around 7 percent of UK GDP[2], around half of that comes from outside London. It directly employs 1.1 million people in 2013 with around two-thirds of whom are outside London. When related professional services are considered, the UK workforce in financial services numbers nearly 2.2 million, these include people in professional services including management consultancy, legal services and accounting services. In 2011–12 the sector contributed 12 percent of PAYE income tax and national insurance, and 15 percent of onshore corporation tax received by Exchequer.

The sector plays a vital role in providing services to the world, with about a quarter of the GB£200 billion revenue comes from activities related to the EU and another quarter with the rest of the world. Consistent with this, the UK has a large trade surplus in financial services with the EU. Though this demonstrates the extent to which the industry benefits from access to the EU market, it also illustrates the reliance of the wider EU economy on the services provided in the UK.

There is no existing FTAs that provide greater access to the EU market than being a member of the EU single market.

- Membership of the EEA grants financial services passport in the same way as EU-authorized firms.
- Being inside the EU customs unions, individual member states are prevented from introducing charges which have an effect equivalent to that of customs duties on goods, however, it doesn't provide access to the EU market for financial services (i.e. Turkey).
- The CETA agreement signed between the EU and Canada contains a financial services chapter and provides, in principle, for trade in financial services under the four "mode of supply"[3] contained in the General Agreement on Trade in Services (GATS). However, in practice firms may have no greater access than under the current third country equivalence regime.
- Switzerland, through its membership of the European Free Trade Area (EFTA) and a series of bilateral agreements, has secured market access in a number of areas. Yet, its access to the market for financial services is limited to an agreement on the supervision of non-life insurance services and it is largely reliant on WTO GATS terms. As a third country, Switzerland has been deemed equivalent under Solvency II and under the European Market Infrastructure Regulation (EMIR) in respect of central counterparties (CCPs). Equivalence determinations under the Alternative Investment Fund Managers Directive (AIFMD) and the Markets in Financial Instruments Directive (MiFID) are in train.

In the absence of a deal, UK and EU would fall back on WTO terms, and in particular the GATS. Under GATS, WTO members must ensure "treatment of services and suppliers from other member no less favorable than that accorded to like services and suppliers of any other country." Typically, GATS members make limited commitments with respect to cross-border supply and consumption abroad of financial services. Under GATS, members are able to impose licensing or other requirements that make it difficult for a non-resident supplier to conduct business. GATS also includes a "prudential carve-out," which enables members to take measures for prudential reasons which could lead to introduction of measures that effectively reduce cross-border supply.

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[1] The box draws on House of Lords European Union Committee 9th Report of Session 2016–27 Brexit: financial services.

[2] Including insurance and other activities auxiliary to financial services and insurance activities.

[3] GATS divides trade in financial services into four "modes of supply": 1, cross-border supply; 2, consumption abroad; 3, establishment; and 4, presence of natural persons. Commitments to market access vary depending on the model of supply.

Box 1. The Financial Sector (continued)

Following Brexit, if the UK firms were to lose full access to the single market, the UK would be classed as a "third country" and its firms could still access the EU market and retain equal treatment in some specific activities where the UK demonstrates regulatory equivalence with the EU. It is clear that the third-country equivalence regime covers a narrower set of activities than those covered by the passporting regime. In particular, it excludes activities such as deposit-taking and lending, retail asset management and payment services. Some of the major activities covered and not-covered by third-country equivalence provisions are:

- There is no third country regime under the Capital Requirements Directive (CRD IV) regime that covers banking services, including deposit taking, lending and other forms of financing, financial leasing and payment services, some corporate finance advisory services and some trading services.
- On the other hand, third country insurers can provide services by establishing a branch within the EEA, authorized in the member state in which it is established. A third-country equivalence regime exists under Solvency II for reinsurance but not for direct insurance.
- MiFIR which came into force in January 2018 introduced a third-country regime that allows banks and investment firms from third countries to provide services related to securities, funds, and derivatives, including trade execution, investment advice, underwriting and placing of new issues and the operation of trading facilities.
- Investment funds that meet the rules set out under the directive on undertaking for collective investment in transferable securities (UCITS) may be sold freely, including to retail investors, throughout the EEA on the basis of single national authorization, however, there is no third-country regime under UCITS, so were the UK to become a third country UK-based asset managers wishing to continue marketing these products would have to re-domicile. Alternatively, funds could be marketed from the UK as alternative investment funds (AIFs).
- The AIFMD sets the rules for alternative investment fund managers. A national private placement regime (NPPR) exists to allow non-EEA fund managers to market funds in EEA jurisdictions to professional investments. AIFMD envisages that the NPPR will be phased out; it does, however, contain third-country equivalence provisions, which could enable UK firms to market their funds.

Moreover, equivalence is potentially vulnerable to changes in regulations, and the process of demonstrating equivalence can be burdensome. Third country equivalence is granted by the European Commission and can be revoked at very short notice. Moreover, the decision process of granting equivalent is lengthy, with no time limit, and could be politicized.

It is tremendously difficult to determine the extent to which firms currently rely on passporting and the degree to which equivalence provisions might provide a substitute. This partly, due to the sheer volume of the passports issued by the FCA and PRA to financial firms. Moreover, firms have more than one passport in order to provide different services under different directives. While equivalence does not replicate passporting, particularly in relation to market access, it may provide third country firms with equal treatment to domestic firms and can, to some extent, reduce frictional costs – although it is difficult to estimate the value of these and the impact those costs have on firms' locational decisions. Last but not least, the legislation underpinning access to the EU market is based largely on regulation of activities and does not map easily onto business structures of many firms.

Box 1. The Financial Sector (concluded)

The impact of a reduction in market access is made even more difficult by the existence of the so-called UK financial "ecosystem," in which network effects resulting from the concentration of services increase the efficiency of the system. The UK currently benefits from the co-location and interconnection of firms providing a range of financial and professional services; thus, a change to the business conditions for one of those services could have spillovers to others. The EU, as a major consumer, also benefits from the efficiencies created by the ecosystem.

Box 2. The Automobile Sector[1]

In general, the business model for volume vehicle producers is to use UK sites to supply the European market. The industry performs well on labor productivity, and university collaboration, but is lacking in areas such as labor costs, skills, and strength-in-depth of the supply chains and government investment in R&D. The sector created GB£14.5 bn in gross value added in 2016 (about 0.8 percent of total GVA). In the same year, it directly employed 159,000 people with a further 238,000 in the wider supply chain. There are regional concentrations in the West Midlands, North West and North East. Nearly 7 percent of the total workforce in automotive manufacturing comprises EFTA nationals, higher than the economy average of 5 percent. In 2016, it accounted 1.1 percent (GB£3.6bn) of the UK total business investment, and carried out GB£3.4bn of research and development.

The sector is export intensive, generated GB£40.1 bn in exports in 2016 (out of which GB£18.3 bn is to the EU). Just over half of the total value added embodied in the gross exports of the UK automotive industry reflects value added generate in the UK (TiVA: origin of value added in gross exports, Dec 2016). The other half reflects the value generated abroad, of which 24 percent is from within the EU. About 10 percent of total UK imports was linked to the automotive industry with 85 percent imported from EU. Around six out of ten of industry imports are from three EU countries such as Germany, Belgium, and Spain.

UK based vehicle makers operate a sophisticated, globally integrated supply chain, to support their "just in time" production models. There are nearly 3000 businesses operating in the UK automotive manufacturing sector with the vast majority (about 90 percent) being small and medium sized enterprises at the Tier 2 level (a tier 1 is a supply chain company supplying components or parts directly to the producer, a tier 2 supplies to a tier 1). The UK vehicle makers sourced 44 percent of the value of their parts from domestic suppliers, rising form 36 percent in 2011, but still below the 50 percent reported in France and Germany. This suggests the majority of the automotive sector's key profit margins is related to efficiency of the supply chain.

The "just in time" production model is underpinned by the EU regulatory regime. To sell a vehicle in the EU, the vehicle must be checked by an EU type approval authority. The authority will check that the "whole vehicle" complies with up to 60 separate technical requirements, by ensuring that there is an individual approval for each system on the vehicle. The existing regime ensures the efficiency despite the high safety and environmental standards:

- The EU customs union prevents member states imposing customs duties or formalities on goods imported from other member states. In addition, these rules prevent member states imposing restrictions on the quantity of imports and exports of a particular item (i.e. quotas or an import or export ban). The single market prevents non-tariff barriers that may restrict imports and exports in less

[1] The box draws on Department for Existing the European Union automotive sector report.

Box 2. The Automobile Sector (concluded)

direct ways, for example, by applying product standards and regulations that make it harder in practice for goods coming from one member state to be sold in another. The EU legal framework has been achieved by establishing a common set of product rules.

- The UK government implements EU legislation on harmonized vehicle standards for relating to all road vehicle manufacturing. Regulatory barriers are one of the industry's most significant concerns, in relation to international trade with non-EU markets. These include differences in local testing and certification requirements, and application of technical regulations different to those agreed globally.
- All new vehicles sold in the UK must be type approved (whole vehicle approval) by an EU type approval authority prior to registration. This is a process that ensures vehicles irrespective of where they are produced comply with relevant environmental, safety and security standards and account for both the United Nations Economic Commission for Europe (UN-ECE)[1] and EU led regulations. Whole vehicle type approval brings together all the individual system and component approvals for a vehicle into a single legal document enabling a manufacturer to demonstrate that it complies with all the relevant technical requirements. The manufacturer can then produce subsequent vehicles in conformity with the original approval and issue a certificate of conformity for each vehicle.

If UK and EU were to trade under WTO terms, UK car manufactures need to meet the requirements set out by the EU, in particular vehicle standards legislation. Importers and distributors of automotive products from manufacturers based in third countries must satisfy themselves that the products comply with EU legislation, including type approvals from a type approval authority. These manufacturers would also need to comply with legislative requirements in their home country. Moreover, goods imported into the EU from non-EU countries must pay a tariff under the WTO MFN tariff schedule. Thus, many countries negotiate bilateral agreements to reduce the regulatory barriers:

- EU-South Korea FTA includes a provision on the mutual recognition of vehicle type approvals. The provision establishes that a type approval issued by one party's "competent authority," confirming conformity with the relevant UN-ECE regulations, must be accepted by the other party as providing proof of conformity.
- EU-Swiss agreements and the EEA goes one step further on mutual recognition. For example, the EU-Swiss mutual recognition agreements include a chapter on motor vehicles, which allows for mutual recognition of vehicle type approvals, and is linked to an agreement that recognizes Swiss legislation as equivalent. Where legislation is deemed equivalent, EU type approvals will be recognized as proving conformity with Swiss legislation, and vice versa.
- EEA agreement, EEA countries adopt EU product legislation into their domestic legislation, and goods that originate from these countries are treated as products from Member States.

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[1] The globally harmonized regulations of the UN-ECE, accepted in more than 50 markets, help to minimize the costs arises from different regulatory standards. But the UN-ECE standards relate predominantly to safety; while the EU adopting the safety regulations developed in the UN-ECE, the EU develops its own environmental regulations. For example EU Regulation deliver reductions in CO2 emissions from new cars and vans sold in the single market and the EU emission standards define the limits for exhaust emissions of new vehicles sold in the EU. The UK will be a member of the UN-ECE 1958 Agreement after existing the EU.

Box 3. Experiences with ALMPs in Germany

With the goal to adjust the skills of the East German workforce to the need of a Western market economy, active labor market policy has been used at an unprecedently high scale during the transition in East Germany in the 1990s, with a particular focus on public sector sponsored training. Annual entries into training programs were around 250 thousand during the years 1993 to 1996. In comparing to other country experiences, there are five specific aspects of the East German experience: 1, participations had fairly high levels of formal education; 2, access to treatment was easy with low targeting; 3, there is little experience in the past; 4, predictions about the catching up process of East Germany and about future trends of labor market tend proved to wrong; and 5, the duration of training programs was long.

Literate suggests positive long-term employment effect from more-targeted government sponsored training programs. Fitzenberger and Volter (2007) evaluate the effectiveness on employment of three government sponsored training in Germany. They find positive medium- and long-run employment effects of the latest program - Specific Professional Skills and Techniques (SPST). The SPST program intends to improve the starting position for finding a new job by providing additional skills and specific progression knowledge in medium-term courses, including refreshing specific skills, e.g. computer skills. It involves classroom training as well as acquisition of professional knowledge through practical work experience. After successfully completing the course, participants obtain a certificate indicating the content of the course which includes any new acquired new skills. In contrast, they find no consistent evidence of positive employment effects for either the Practice Firms program which is shorter in duration with the goal of providing more general skills, nor the long-duration retraining program which is a far more formal the thorough training on a range of professional skills.

H. Appendix: Econometric Tests

Text Table A1: Long Run Cointegration Relationship: Sectoral Labor Share

Dependent variable:	**Relative labor share**	
Relative sectoral GVA	0.37***	
	(0.01)	
Relative sectoral price	0.19***	
	(0.01)	
Constant	-1.81***	
	(0.04)	
Global trend	Yes	
sector*country dummy	Yes	
Observations	5,427	
R-squared	0.99	
Panel Cointegration Tests 1/		
	Statistics	p-value
Modified Phillips-Perron t 2/	-6.56	0.00
Phillips Perron t 2/	-5.15	0.00
Augmented Dickey-Fuller t 2/	-5.3	0.00

1/ Unit root test results are available upon request.
2/ H0: No cointegration; H1: All panels are cointegrated.

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LONG-TERM FISCAL CHALLENGES IN THE UK[1]

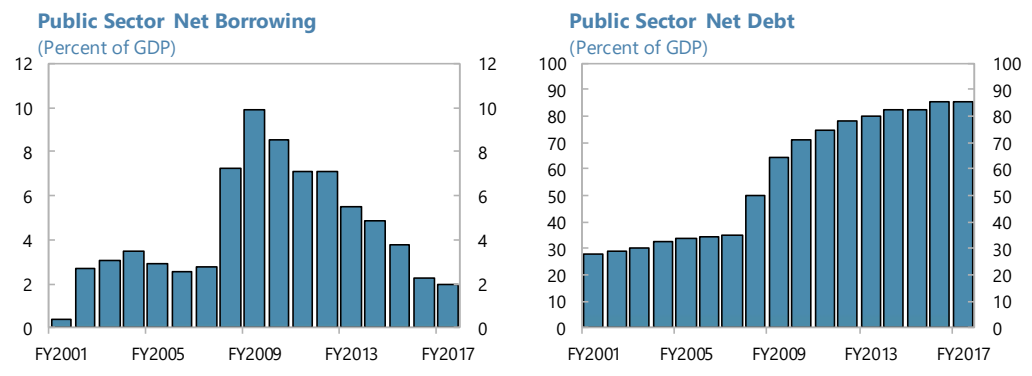
A. Introduction

1. Sustained consolidation has substantially reduced the UK's budget deficit since the height of the global financial crisis. The headline deficit has declined from 10 percent of GDP in 2010 to below 2 percent in 2017. Last year, the cyclically-adjusted primary deficit was virtually eliminated and the general government gross debt to GDP ratio declined for the first time since the crisis.

2. Nevertheless, public debt remains high and vulnerable to shocks. At 86 percent of GDP, the public debt ratio remains relatively high by international standards, and substantially higher than the median for rating peers. All three of the main credit rating agencies have downgraded the UK's sovereign debt rating since the referendum on EU membership, pointing to rising spending pressures, an erosion of medium-term growth prospects, and risks to the financing of the current account deficit. The authorities' fiscal stress tests and staff's debt sustainability analysis (see IMF UK staff reports, 2017 and 2018) indicate that the fiscal position is highly sensitive to negative macroeconomic shocks.

3. Steady fiscal consolidation remains critical to rebuild buffers against future shocks and set debt on a firm downward path (UK IMF Staff Report 2018)**.** Governments with high levels of debt are more vulnerable to economic shocks and have less room for counter-cyclical fiscal policies to mitigate their impact on households and business (IMF Fiscal Monitor April 2018). It is important that public finances are managed prudently during more favorable times to ensure that when shocks materialize they do not put the public finances onto an unsustainable path (IMF UK staff Report 2018, Box 2). The fiscal framework adopted by the authorities prudently aims to reduce the deficit (after accounting for the impact of the economic cycle) to below 2 percent of GDP by 2020/21, and to balance the budget by the middle of the next decade.

Figure 1. Public Sector Deficit and Net Debt



Source: OBR Public Finances Databank, September 2018.
Note: Chart 2 is computed using debt at end March and GDP centered on end-March.

[1] Prepared by Nicolas Arregui (EUR).

4. Over the medium to long term, population aging will put significant pressure on the public finances, while productivity developments and Brexit-related effects may make consolidation more challenging. Annual spending on healthcare, long-term care and pensions is projected to increase by more than four percentage points of GDP between 2023 and 2043 (OBR 2018). Output losses associated with Brexit, or a failure of productivity growth to recover more generally, would shrink the revenue base from which to meet these spending demands. If Brexit leads to the movement of a meaningful share of the relatively tax revenue-rich financial sector outside the UK, available revenues could fall even faster. Taken together, this means that the UK may in the future face difficult decisions about the desired size of its public sector, as well as the mode of delivery and financing of public services.

5. This note analyses the challenge posed by increasing age-related spending pressures, including its main drivers going forward.

- ***Health.*** At around eight percent of GDP, public health spending is above the mean for OECD countries, but is broadly in line with a benchmark based on income per capita, old-age-dependency ratio and income inequality. A variety of macro and micro level cost-containment controls are or have been in place. Nevertheless, health spending is projected to be the largest source of age-related pressure on the public finances, driven significantly by cost-pressures. As sizable as these pressures may be, they are not out of line with those projected for other advanced economies.

- ***Pensions.*** Payments related to pensions account for a significant share of public sector expenditures and liabilities. At the same time, public spending on the elderly is relatively low compared to other countries, reflecting in part a smaller elderly population and a higher prevalence of private voluntary pensions, which are incentivized with tax exemptions. The generosity of the state pension eroded over a period of nearly three decades, but has partly recovered over the last decade. Public spending on pensioner benefits is projected to increase significantly over the medium to long term, with a notorious contribution from the indexation policy (i.e. triple-lock indexation).

6. This paper then discusses three broad policy alternatives:

- ***Reining in pressures in health and pensions, or being less ambitious on what benefits to expect.***

    - ***Health.*** Analysis based cross-country data suggests there is room for further efficiency gains in health care: potential gains in public health expenditure efficiency are above the median for advanced economies. Additionally, higher cost-sharing through user fees could be considered: the share of out-of-pocket payments is lower than the mean for other advanced countries.

    - ***Pensions.*** Further increases in the state pension age (beyond those already legislated) may be needed as life expectancy continues to increase, although it should not be the sole

means of adjustment, as it may disproportionately affect certain groups of society with lower-than-average life expectancy. Switching from the triple lock guarantee on state pensions—which guarantees an annual increase in the state pension payment equal to the highest of 2½ percent, CPI inflation, or the rise in average earnings—to a more sustainable method of indexation will be required. It is worth noting that moving to a double-lock indexation system (i.e. state pension would be increased over time in line with the highest of average earnings growth or inflation) is likely to make only a small difference in long-term fiscal sustainability. Finally, means testing for access to social benefits in old age could also be used to improve sustainability while safeguarding the most vulnerable. Alternatively, similar redistribution objectives could be pursued by using the tax system, while preserving a simple and clear structure for state pensions.

- ***Cutting spending in other areas.*** Deficit reduction since the financial crisis has relied mostly on spending measures. Spending restraint also accounts for the bulk of planned consolidation over the next three years. By 2020, most categories of public spending as a ratio to GDP will be at or below their levels prior to the crisis. The scope for further reductions in other areas may be limited following several years of consolidation, and the need to invest in human and physical capital to boost productivity.

- ***Raising additional revenue.*** While the government should continue to seek the best value for money in public spending, in many areas, identifying further efficiency gains without reducing the quality of services could become more difficult, highlighting the need for additional revenue measures. The tax burden is at the highest level in three decades, but the UK still has a lower tax environment compared to the mean for advanced economies. Given the scale of revenue needs over the long term, increases in broad-based taxes would likely be required. "Hard" earmarking of tax increases may not advisable, as it may introduce volatility in health revenues and increase budget rigidities.

B. Health and Pension Spending Pressures Background

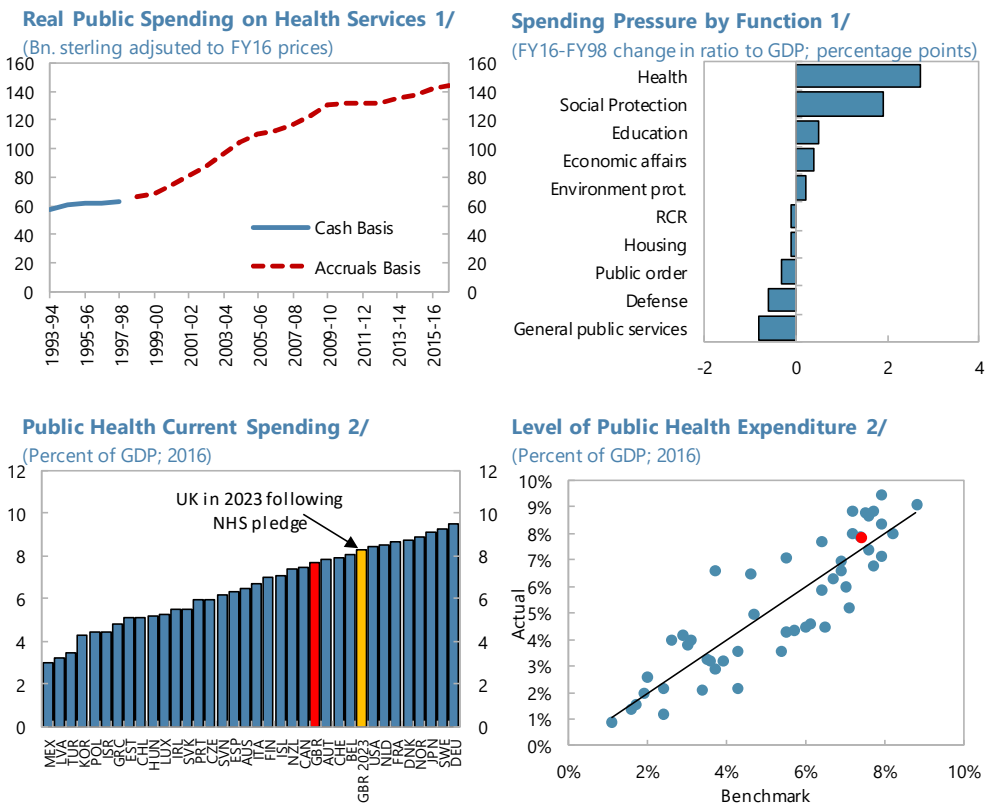
Health Spending Pressures

7. The UK provides universal public healthcare coverage to all permanent residents. Health coverage is largely free at the point of use, and is mostly paid for by general taxation (including employment-related insurance contributions). The precise scope is not defined in statute or by legislation, and there is no absolute right for patients to receive a particular treatment. However, there is a statutory duty to ensure comprehensive coverage. In practice, the National Health Service (NHS) provides or pays for preventive services, including screening, immunization, and vaccination programs; inpatient and outpatient hospital care; physician services; inpatient and outpatient drugs; clinically necessary dental care; some eye care; mental health care, including some care for those with learning disabilities; palliative care; some long-term care; rehabilitation, including physiotherapy; and home visits by community-based nurses (Thorlby and Arora, 2015). To varying degrees, devolved administrations and local authorities make decisions about the what volume and

scope of these services are provided given budgetary constraints. Unmet needs for medical care are generally low, and coverage is highly equitable with narrow differences in access to care between income groups (European Commission 2017).

8. Public expenditure on health services has increased significantly over the last 60 years, both as a share of public expenditure and as a share of national income. Public health expenditure has been the most significant spending pressure for the last two decades: it doubled in real terms from the late 90s until the global crisis, and it continued to increase at times of austerity policies, albeit at a slower pace.[2] It currently accounts for nearly one fifth of the UK government's total managed expenditure (PESA 2017). At around eight percent of GDP, public health spending is above the mean for OECD countries, but broadly in line with a benchmark based on income per capita, old-age-dependency ratio, and income inequality (Figure 2).

Figure 2. Public Health Expenditure

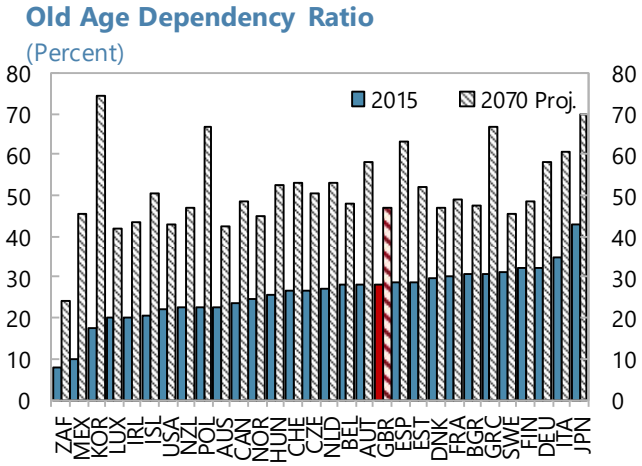


Source: HMT Public Expenditure Statistical Analyses (PESA 2017); OECD Health Accounts; ONS and IMF staff calculations.
1/ Real terms figures are the nominal figures adjusted to 2016-17 price levels using GDP deflators from ONS.
2/ Contribution of the NHS pledge computed as the change in health spending to GDP ratio in OBR FSR 2018. Benchmark obtained as fitted value from cross-country regression of public health expenditure on relative per capita income, old age dependency, and income inequality (Gini coefficient).

[2] Under the Labour government from 1997–98, real growth in spending on health accelerated, contributing to the longest period of sustained real spending growth seen in the history of the NHS. These substantial increases in health spending were determined in light of the recommendations of the Wanless Review, an independent review of the health service in the UK that concluded an average annual real increase in NHS spending of 4.2–5.1 percent over the 20 years between 2002–03 and 2022–23 would be required to deliver the 'high quality health service' envisaged (IFS 2015).

9. The rise in real public health spending has been driven by a combination of demographic trends, income effects, and non-demographic cost-pressures.

- **Demographic trends.** An aging population raises the share of GDP spent on health and long-term care, as elderly people typically consume more and more expensive health care. Between 1976 and 2016 there was a four-percentage point increase in the share of population aged 65 and over, given the steady increases in life expectancy and the post-war baby boom reaching retirement (Figure 3).[3] Migration has also affected the age structure of the population, both directly (migrants to the UK are typically in working age) and indirectly (as on average non-UK born mothers have more children than UK-born mothers). Demographic effects have explained little of the increase in health spending over past decades, although they are expected to become a growing driver of spending going forward as demographic pressures are expected to accelerate. Indeed, the proportion people aged 65 and older is projected to grow to about a quarter of total population by 2050 from 16 percent today, driven in part by continued life expectancy gains and as the 1960s baby-boom generation reaches retirement age (ONS 2017). Demographic pressures in the UK are in line with those for other advanced economies.



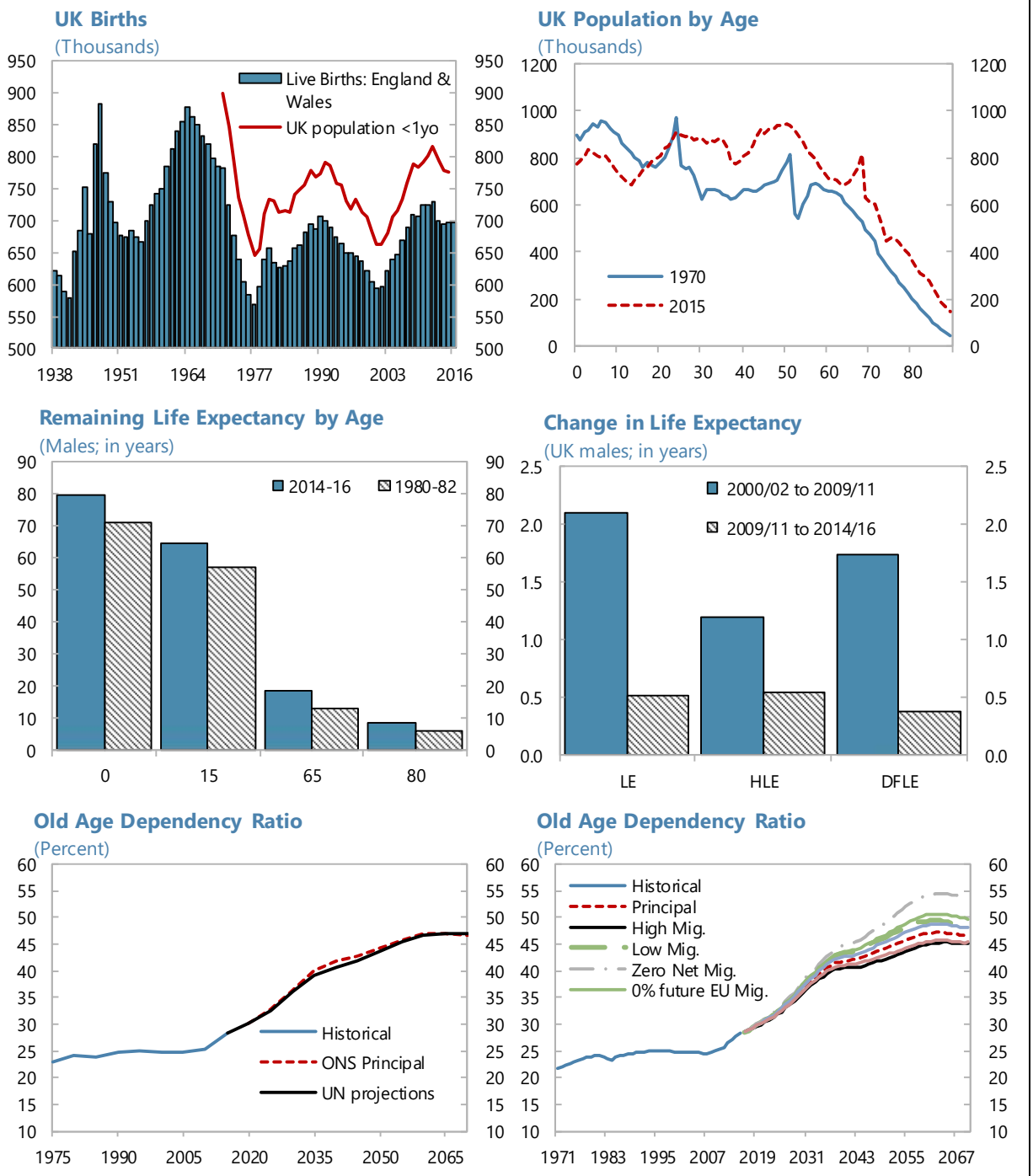
Sources: UN; and IMF staff calculations.

- **Income effect.** Health care is a 'normal good,' meaning that demand increases as income rises (Figure 4). Studies of past trends in health spending show that the income effect is a significant driver of real term increases – though with an estimated elasticity typically close to one, this does not account for the rising share of GDP devoted to health spending.

- **Non-demographic factors**, such as increasing relative health care costs, technological advances, prevalence of chronic conditions, and lifestyle changes, have been a key driver of spending in the past and are likely to remain important in the future (Box 1). As such, it has been these residual factors that have largely explained the past rise in health spending as a share of GDP (European Commission 2013 and 2015, and OECD 2013).

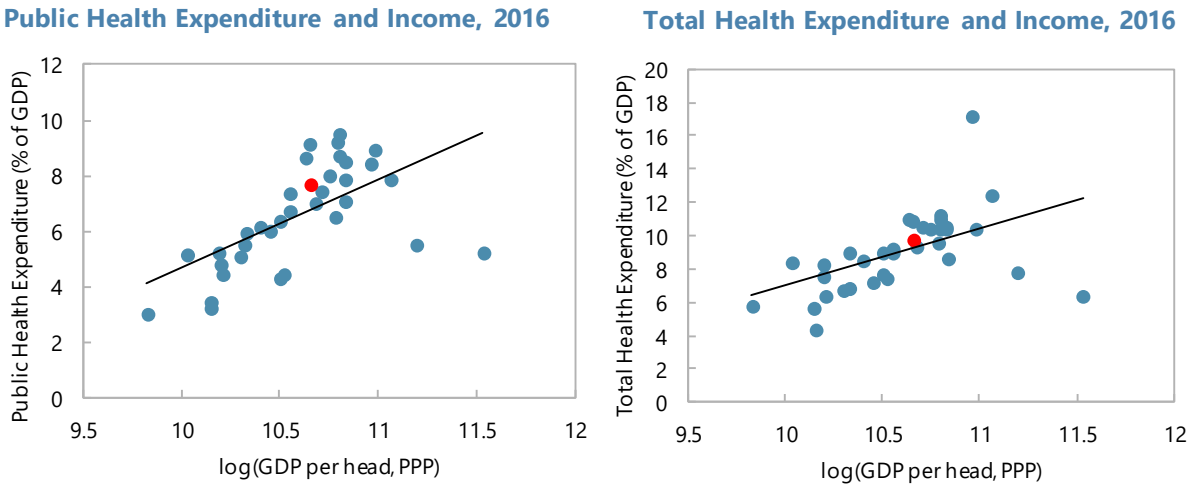
[3] The impact of life expectancy gains on health expenditures depends on how the extra years are spent in good or in bad health.

Figure 3. Demographic Trends



Sources: ONS; and IMF staff calculations.
Note: LE = Life expectancy; HLE = Healthy life expectancy; DFLE = Disability-free life expectancy.

Figure 4. Income Effect



Sources: OECD Health Accounts; and IMF staff calculations.

Box 1. Non-Demographic Cost Pressures

The methodology in OECD (2015) allows to quantify the role played by different drivers in explaining the average real growth in public expenditures. The impact of demographic trends is computed using the UN population projections by age, and the representative age profile for health expenditures (obtained from OBR FSR 2017). The income effect is computed by multiplying an assumed income elasticity by the growth rate in real per capita GDP (elasticities of 1 and 0.8 are considered). Finally, the non-demographic cost pressures are estimated as a residual, after controlling for the demographic trends and income effects.

UK public spending on health has increased by 3.6 per cent a year on average in real terms from 1985 to 2015. As shown in the table below, income effects and non-demographic cost pressures explain the bulk of the real growth, while demographic trends have played a more minor role. The relative importance of different drivers is broadly robust to changes in the time period considered (for instance, the exclusion of the most recent austerity period).

Drivers of Average Yearly Real Growth in UK Public Health Spending

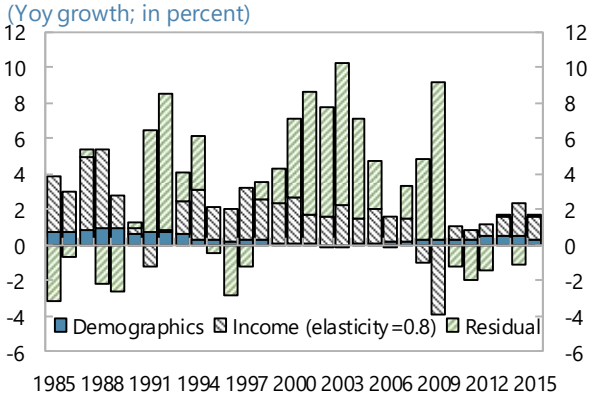
	From 1985 to 2015	From 1995 to 2009	From 1995 to 2015
Demographics	0.41	0.18	0.25
Income (0.8)	1.49	1.36	1.26
Income (1)	1.87	1.70	1.58
Residual (0.8)	1.67	3.15	1.99
Residual (1)	1.30	2.81	1.68
Average	3.58	4.70	3.51

Source: OBR 2017, ONS, PESA 2017, UN Population Projections, and IMF staff calculations.

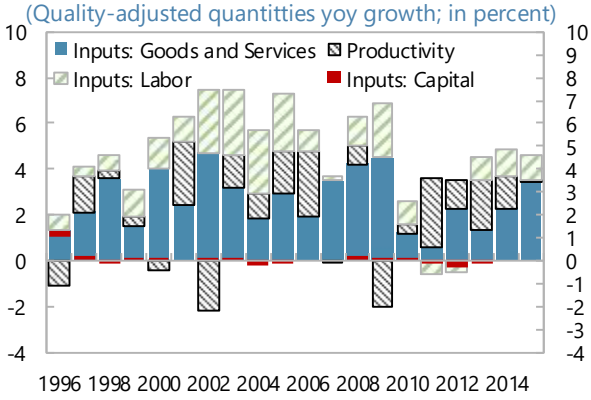
Box 1. Non-Demographic Cost Pressures (concluded)

Tracking the public health spending decomposition over time shows that since 2010 spending growth has been typically below the level that would be expected based on demographics and income effect (i.e. negative residual). At the same time, growth in quality-adjusted public service health care output was underpinned with contributions from productivity gains, albeit to a decreasing degree.

Real Public Health Spending Decomposition
(Yoy growth; in percent)



Public Service Healthcare Output
(Quality-adjusted quantitties yoy growth; in percent)



Sources: OBR; OECD; ONS; PESA; and IMF staff calculations.

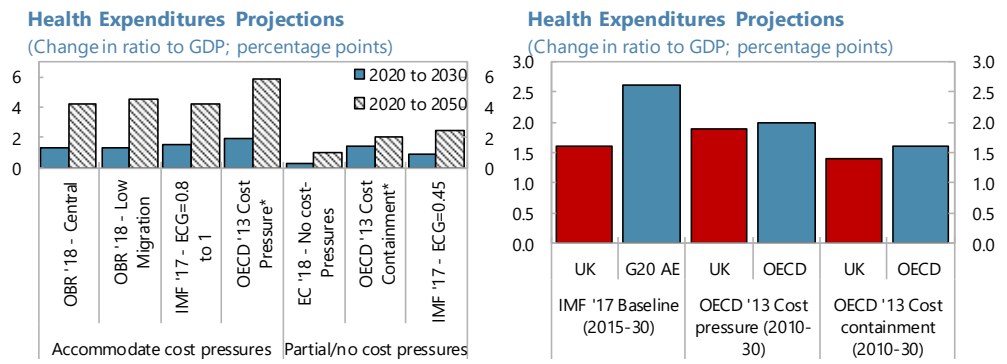
10. Health spending is projected to be the largest source of age-related pressure on the public finances, driven primarily by cost-pressures. OBR projects spending on health over the long term, taking into account the changing size and age structure of the population and assuming that health spending per person of a given age and sex grows in line with average earnings.[4] These projections illustrate that demographic pressures alone could put upward pressure on health spending of 0.8 percent of national income between FY2023 and FY2041, and of 1.2 percent of national income between FY2023 and FY2067. However, other cost pressures, such as increasing relative health care costs and technological advances, are projected to be a more significant source of upward pressure on spending. Once an estimate of cost pressures is incorporated, the OBR projects health spending increasing by 2.7 percent of national income between FY2023 and FY2041, and by 6.1 percent of national income between FY2023 and FY2067. International institutions such as the IMF and OECD have also emphasized these other cost pressures to be a key source of future spending growth. For example, the OECD (2013) has assumed in its 'cost-pressure scenario' that other cost pressures increase spending by 1.7 percent a year beyond what would result from demographic change and income effects. The IMF (2010, 2012) has estimated an additional cost pressure for the UK of about 1.5 percent a year between 1980 and 2008 and 2.2 percent a year

[4] Projections assume that healthy life expectancy rises proportionately with total life expectancy.

between 1995 and 2008.[5] As significant as the projected increases in pension spending may be, they are not of line with those projected for other advanced economies.

11. Public adult social care spending also faces upward pressure from the ageing of the population and is expected to have a negative impact on public finances.[6] With increasing demand, pressures on social care have risen.[7, 8] The government has recognized these pressures, with £2bn of additional funding announced in the Spring Budget 2017, and allowing councils to raise additional council tax exclusively to pay for social care. Based on current policies continuing, long-term care spending is projected to increase by 0.5 percent of national income between 2017–18 and 2041–42, and by 0.8 percent of national income between 2017–18 and 2067–68 (OBR 2018). The 2014 Care Act aimed to limit individuals' risk of catastrophic long-term care costs by imposing a cap on out-of-pocket expenditure, which could pose additional spending pressures going forward. However, in July 2015, this provision was postponed until 2020 over cost concerns. Moreover, in December 2017, the government announced it would not implement a cap on care costs in 2020, with the new plans to be set out after consultation.

Figure 5. Health Expenditure Projections



Sources: OBR; OECD; IMF 2017; IMF 2010; and IMF staff calculations.
Note: OBR 2018 projections are the only projections to incorporate the NHS additional funding announcement from June 2018.

[5] NHS England (2016) has recently estimated non-demographic cost growth pressures for the NHS up to 2020–21 by stripping out an estimate of demographic cost pressures from activity in 20151–6. This suggests that on average other cost pressures added 2.7 and 1.2 percentage points to growth in primary and secondary care spending in 2015–16 respectively (OBR 2017). The size of the effect varies significantly by spending category, being particularly large for prescribing and specialized services. By contrast, demographic factors are similar across most services, contributing on average around 1.3 percentage points to growth in total activity.

[6] Adult social care refers to support people need because of age, illness, disability or other circumstances. Publicly funded adult social care is a responsibility of local government, it is funded by a combination of central and local taxation and payments by individual service users, and is subject to needs and means-testing (i.e. unlike health care, it is not universally free at point of use).

[7] With large reductions in local authority funding since 2009–10, NHS funds have been increasingly directed to fund traditional social care activities, for example, through the Better Care Fund (IFS 2017). Taking NHS transfers to local authorities into account, real public spending on social care organized by English local authorities fell by 1 percent between FY2009 and FY2015 (IFS Green Budget 2017) despite having increased from FY2013 onwards.

[8] There has been an increase in the number of days during which beds in acute hospitals have been occupied due to delayed transfers of care. Patients waiting for a care package at home or at a nursing home placement was responsible for over half this increase (OBR 2017).

12. A variety of macro and micro level cost-containment controls are already in place. Following the IMF (2010) taxonomy, these include:

- **Budget caps.** Costs in NHS are constrained by a global budget set at the national level on a multi-year cycle.

- **Supply constraints.** Output controls on treatment coverage are informed by the National Institute of Clinical and Healthcare Excellence, which provides guidance on treatments for the NHS to fund based on evidence and cost-effectiveness analysis.

- **Price controls.** Wage controls for healthcare professionals have been in place as a result of a broader public sector wage increase cap, at 1 percent since 2013–14. National tariffs or prices are set for each "type of care" reflecting its average cost.

- **Public management and coordination.** Primary care is delivered mainly through general practitioners, who are normally patients' first point of contact and act as gate-keepers for secondary care. Services are allocated by need and waiting lists.

- **Market mechanisms.** In England and Northern Ireland, there is a there is an internal market within the NHS, in which buyers (commissioners) are separated from suppliers (hospitals).[9] Commissioning groups manage regional budgets and fund care for resident population. Patients are free to choose the GP of their choice, as well as any NHS hospital (provided their GP is willing to refer them). Patient information is readily accessible online through NHS Choices (England), SHOW Scotland, NHS Direct Wales, and NI Direct. Reforms from the mid-2000s and onward that increased choice competition between publicly run hospitals improved competition and patient outcomes (McGuire and Van Reenen 2015; Cooper et al 2014).[10] The UK has made much progress with generic medicines making up a much higher proportion of pharmaceuticals than in most other EU countries (EC 2017). There are also efforts to address variations in treatment and cost by encouraging benchmarking and best practice (Briggs, 2012; Carter, 2016).

- **Addressing behavioral risk factors.** Behavioral risk factors such as tobacco, alcohol consumption, diet, and physical activity, account for a significant share of the overall burden of disease. Work to promote healthy lifestyles appears to be producing some positive results, with decreasing smoking levels and reductions in alcohol use.[11] However, binge drinking remains elevated, and obesity reduction efforts have had less impact. Starting in 2018, a tax on sugary

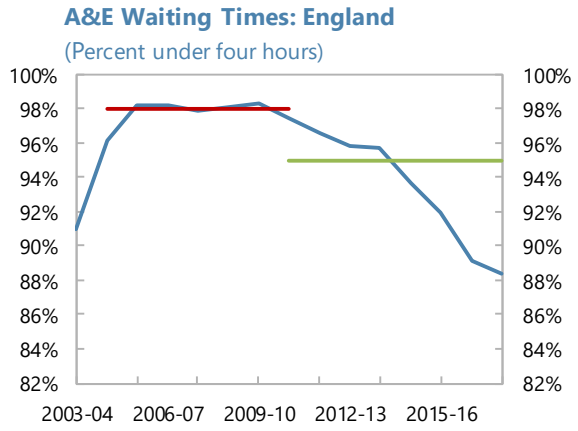
[9] Scotland and Wales abolished the purchaser–provider split and have been less market focused. There has been little assessment of the efficiency of the separate health care systems across the four constituent nations of the UK. The analysis that has been undertaken finds little consistent evidence that one structure is better than the other (McGuire 2017, Bevan and May 2014).

[10] The success of the 2012 Health and Social Care Act large organizational reforms in strengthening competition is less clear (McGuire and Van Reenen 2015, King's Fund 2015).

[11] The UK has been a leader in tobacco control with tax rises, standard packaging and bans on point-of-sale displays showing results. Action on transport accidents has led to the second lowest mortality in the EU (2014).

soft drinks is introduced. Chocolate and sweets are already included in Public Health England's program aiming for a 20 per cent reduction in sugar by 2020.

13. Although some savings targets have been met in the past five years, financial pressures on the NHS have been mounting. The NHS budget (albeit protected in real terms at a time that several other public services were undergoing consolidation) has been strained by a raising demand, resulting in some deterioration in quality of care. In particular, A&E waiting times targets have been increasingly missed. NHS providers have been in deficit on average since FY2013, requiring offsetting savings to keep the overall spending within the limit set by the government. In light of mounting pressures, recent budgets have repeatedly provided extra money to the NHS to supplement departmental expenditure limits.[12] Funds from the capital budget have also been reallocated to fund day-to-day spending (House of Commons Committee of Public Accounts, 2017). Finally, the 1 percent pay cap for NHS staff was lifted earlier this year, possibly leading to increased cost pressures going forward. While this should facilitate recruitment and retention, it also ends a significant driver of savings over the last years (OBR 2017).[13]



Pension Expenditure Pressures

14. The UK government plays a role in relation to the funding of various pension schemes. This includes:

- The ***state pension*** is a benefit received by all pensioners reaching state pension age who have paid sufficient National Insurance contributions (NICs) into the National Insurance Fund.[14] Although people are required to pay NICs (or to have received National Insurance credits) to qualify for the state pension, there is no direct link between the amounts contributed and the basic state pension received (i.e. it is not earnings-linked). Since April 2011, the government has

[12] Moreover, in June 2018, the government pledged an increase in the funding for the National Health Service over five years, with an average real increase of 3.4 percent per year starting in FY2019. While not out of line with the long-term historical average growth rate, the rate of expansion would be substantially larger than in the post-crisis period, amounting to additional £20 billion (in today's prices) or 1 percent of GDP by fiscal year 2023. The announcement provided no details on how the extra spending will be financed, with details to be provided at a future fiscal event.

[13] The cost of employing people makes up a large part of health care costs (IFS 2017).

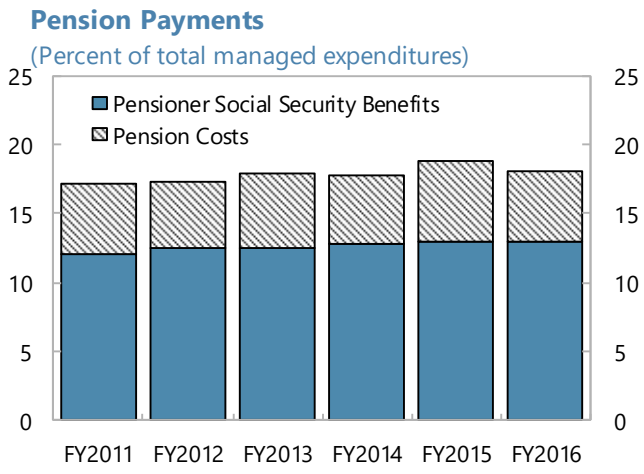
[14] Although there is an expectation it will be provided, the government has no contractual obligation to provide the state pension and could withdraw or change the benefit in future.

committed to a 'triple lock' on the level of state pension received (for both the basic state pension and new state pension) so that it increases in line with growth in the consumer prices index (CPI), average earnings or 2.5 percent, whichever is higher.

- ***Public sector occupational pension schemes*** cover staff working in central government (e.g. civil service, NHS, teachers, armed forces, fire, and police), local authorities and arm's-length bodies including public corporations.[15] Most of the schemes in central government are unfunded pension schemes, whereby today's contributions from current employees and employers are used to pay today's pensions. The Treasury covers any shortfall between the pensions paid and the contributions received and would also retain any surplus.

- The government ***also supports the private sector***, including by regulating private sector pension schemes through the Pensions Regulator and the Financial Conduct Authority, and protecting private schemes if employers become insolvent. For instance, the Pension Protection Fund is an insurance type of arrangement set up to protect members of pension schemes if the sponsoring employer becomes insolvent.[16] There is no contractual government guarantee to cover pension schemes if the assets in the PPF are insufficient to cover the claims. The government also supports private pensions trough the creation of auto-enrollment in workplace pensions (with nearly 10 million eligible jobholders auto enrolled into an AE pension scheme), and via pensions tax relief.[17]

15. Payments in relation to pensions account for a significant share of public sector expenditures and liabilities. Public sector pension schemes constitute the largest liability on the public sector balance sheet, amounting to around 40 percent of total liabilities and 75 percent of GDP. The net public sector pension liability is a continuing long-term commitment that will be payable over a significant number of years. In FY2016, the government's pension payments accounted for nearly 20 percent of total expenditures on public services (£40 billion to former public sector employees and £100 billion in state pension benefits).



Sources: OBR databank; WGA FY16; and IMF staff calculations.

[15] It also includes some employees transferred from the public to the private sector or those working for private sector companies which have been contracted to provide public services.

[16] The PPF usually covers private sector schemes but some funded public sector schemes which fall within a broad definition of the public sector, such as the Transport for London and BBC pension schemes, are also eligible.

[17] In FY2016, gross pension tax relief (i.e. relief on pensions contributions and investment income on pension funds) amounted to £38.6bn and the NICs relief on employer contributions was £16.2bn.

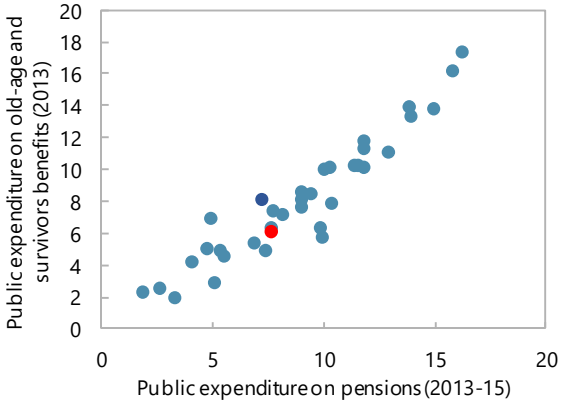
16. At the same time, public spending on the elderly is relatively low and some pensioner segments remain more vulnerable despite the progress over the last decade. Public expenditures on the elderly is below the OECD average, and significantly below the average for European countries, reflecting in part a smaller elderly population and a higher prevalence of private voluntary pensions (Figure 6), which are incentivized with tax exemptions and encouraged through automatic enrollment. The replacement rate for state pensions is one of the lowest in the OECD, although some pensioners have significant assets in occupational pensions and/or in housing (OECD 2017).[18] Net replacement rates are close to the OECD median once private voluntary schemes are taken into account. The generosity of the state pension eroded over a period of nearly three decades, but has partly recovered over the last decade (Box 2). When analyzing the incomes and poverty rates of the elderly relative to the overall population, it is important to take into account housing costs, given the significant gap in ownership rates between the two groups (Figure 7). Controlling for housing costs, the median income for pensioners is in line and poverty rates are lower compared to non-pensioners.[19] Nevertheless certain pensioner segments remain relatively more vulnerable. While earnings and investments make a large contribution to income for those in the top half of the distribution, reliance on state support is more significant at the bottom of the distribution (Department for Work and Pensions 2018). Moreover, relative poverty rates (50 percent of the median income) increase faster with age compared to OECD average.

[18] Moreover, replacement rates do not take into account other state benefits such as health.

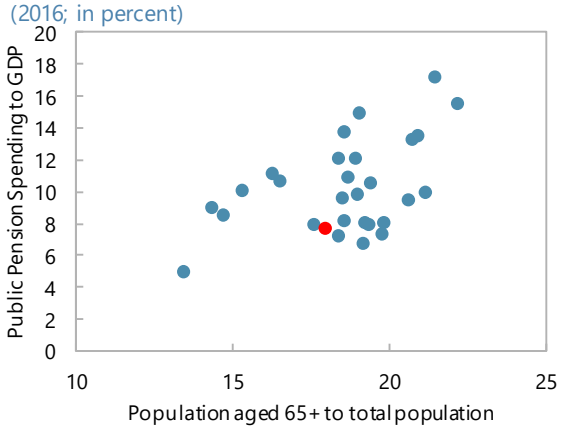
[19] Pensioners have seen their incomes increase more rapidly than the working population since 1997. Between 1997 and 2010, tax and benefit changes introduced by the Labour government favored pensioners, particularly those on lower incomes. Since 2010, pensioners have been largely protected from the tax and benefit changes introduced as part of fiscal consolidation. They have also benefited, relative to younger generations, from house price changes and many have access to generous occupational pension schemes not available to younger cohorts (IFS and Health Foundation 2018).

Figure 6. Public Expenditure on the Elderly

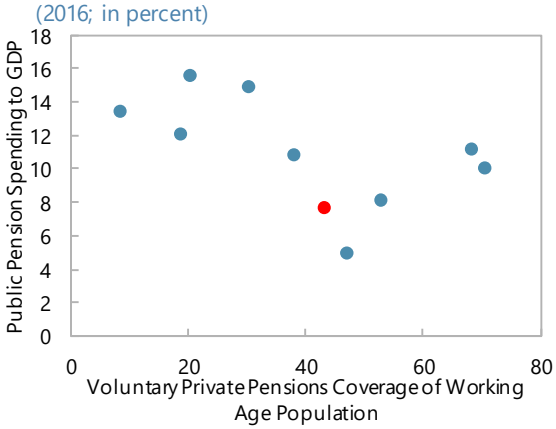
Public Expenditure on the Elderly
(Percent of GDP)



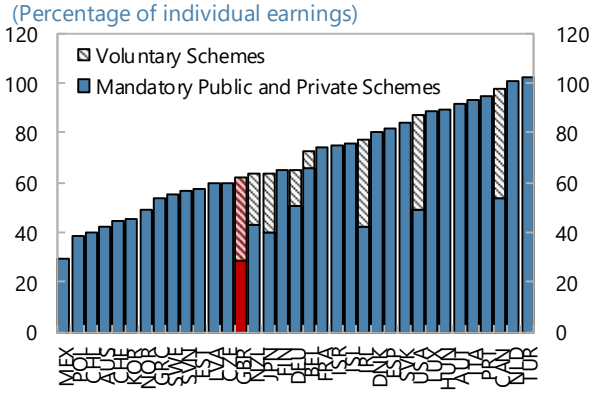
Public Pension Spending and Elderly Population
(2016; in percent)



Public Pension Spending and Private Pensions
(2016; in percent)



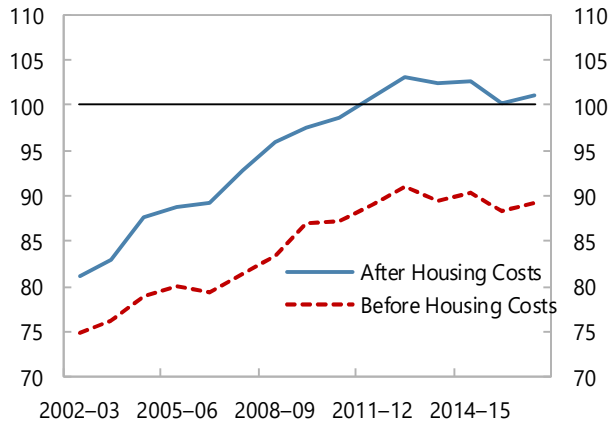
Net Replacement Rates for Average-Wage Earners
(Percentage of individual earnings)



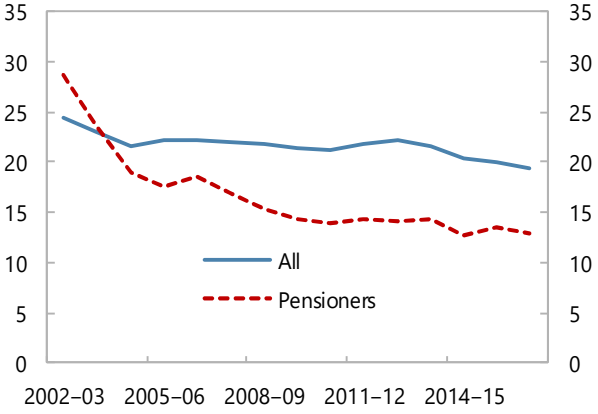
Sources: European Commission Ageing Report 2018, OECD Pensions at a Glance 2017, and IMF staff calculations.
Note: Chart 2 is based only on European countries. Chart 3 is based only on European countries where mandatory private pensions are not applicable, and there is data on total voluntary schemes or for both voluntary and personal voluntary schemes (in which case the total is approximated as the sum of those two). Pension schemes for civil servants and other public-sector workers are generally included in the calculations of Public expenditure on pensions for EU member states: see European Commission 2015 Ageing Report.

Figure 7. Elderly Incomes and Poverty

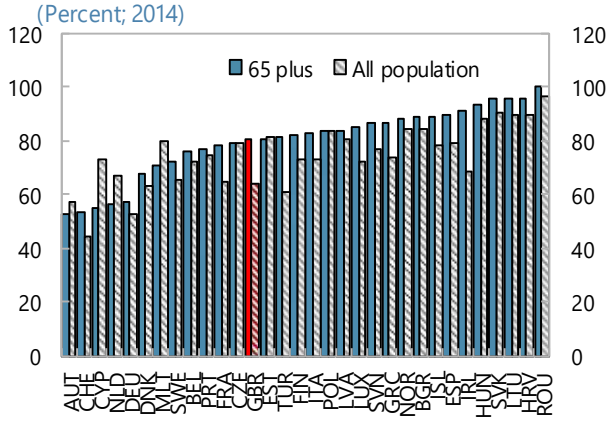
Median Pensioner Income
(As a percentage of median non-pensioner income)



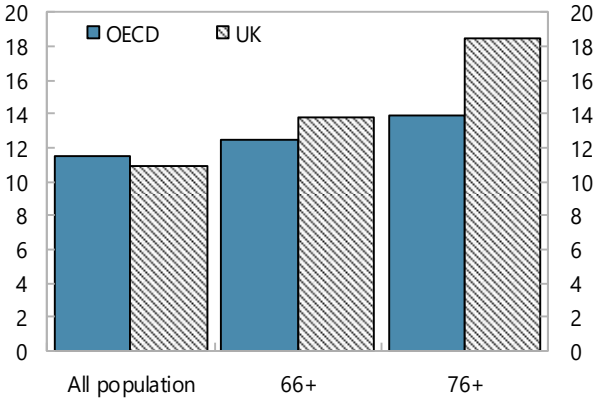
Absolute Poverty Rates - After Housing Costs 1/
(Percent)



Home-ownership Rates
(Percent; 2014)



Income Poverty Rates by Age (Percentage with incomes less than 50% median HH disposable income)



Sources: Charts 1 and 2 reproduced with permission from IFS 2018 "Living standards, poverty and inequality in the UK: 2018"; Eurostat; OECD Pensions at a Glance 2017; and IMF staff calculations.
1/ Absolute poverty rate is defined as 60 percent of median income in 2010-11.

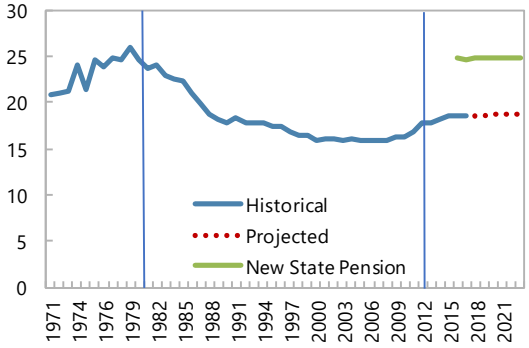
Box 2. State Pension Indexation

Historical View

A statutory link between the state pension and earnings was removed in 1980, linking benefit increases to (retail) prices instead of earnings. As prices tended to rise more slowly than earnings, the value of the state pension declined from 26 per cent of mean full-time earnings in 1979 to 16 per cent in the period 2000–2008.[1]

A combination of economic factors and policy changes since the global financial crisis have resulted in the state pension making up much of the ground it had lost relative to earnings during the 1980s and 1990s.

Full Individual Basic State Pension
(in percent of average full-time earnings)



Source: DWP Annual Abstract of Statistics, OBR EFO 2018, ONS, and IMF staff calculations.
Note: Most pensioners receive more than the Basic State Pension, either from additional State Pension or from private pensions.

- Retail price exceeded average earnings growth for the purposes of state pension uprating in 2008, 2010, and 2011. The 'triple lock' was announced in the June 2010 Budget and implemented in 2012.[2, 3] In 2010, the Government applied a discretionary increase of 2.5 per cent, which exceed average earning growth and both measures of inflation. With the triple lock in place, the state pension increased by more than average earnings in each year from 2012 to 2018 except for 2016, as either CPI inflation or 2.5 per cent exceeded earnings growth. As a result, the state pension increased to around 18.5 per cent of average full-time earnings in FY17, a level not seen since the late 1980s.
- A new state pension (NSP) was introduced for people reaching state pension age from April 2016, at about 25 percent of average earnings (but requiring 35 years of national insurance contributions to qualify for the full rate, instead of 30). [4] This percentage is near the peak observed for the basic state pension before the earnings link was removed in 1980. The triple lock also applies to the new state pension (NSP).

The Government confirmed its commitment to retaining the triple lock until 2020 in the June 2015 Budget, and more recently until the end of this Parliament (see, for instance, HMT Managing Fiscal Risks Report 2018). The government noted the OBR's assessment of the cost of the Triple Lock, which causes the State Pension to continue to grow faster in value than the incomes of the working age population, but highlighted its contribution to reducing pensioner poverty to historically low levels.

[1] In the interim period, the state pension was uprated in line with the Retail Prices Index (RPI), and this indexation was supplemented in 2001 by a minimum annual increase of 2.5 percent. Importantly, most pensioners receive more than the Basic State Pension, either from additional State Pension (for which they have paid higher National Insurance Contributions over their lifetime) or from private pensions.

[2] There are four main components to the UK state pension: basic state pension (flat rate), earnings-related additional benefits, flat rate non-contributory, and means tested benefits. The earnings-related scheme is not part of the new state pension (NSP). Due to transitional arrangements, many people reaching State Pension age now will be getting more than the full rate of NSP.

[3] The link to earnings growth was reinstated by the Pensions Act 2007, following a recommendation by the 2005 Pensions Commission in order to "stop the spread of means testing which would occur if present indexation arrangements were continued indefinitely." It was suggested that means testing undermined incentives to save privately and therefore the prospect of people saving adequately for retirement.

[4]The new State Pension was set to be 'cost neutral,' i.e. the average of what pensioners received on the old system (basic plus additional State Pension awards).

Box 2. State Pension Indexation (concluded)

Cross-country View

"First tier" pensions are provided by the public sector seeking that retirement income meets a minimum standard of living in old age. Different countries have fundamentally different pension systems and comparisons are not straightforward. In broad terms, there are three basic models of public "first tier" pension provision: minimum pensions in earnings-related schemes, basic flat-rate, and a safety-net component. As discussed above, the UK state pension is predominantly flat-rate.

Indexation policies have a much greater impact on retirement income for basic flat-rate schemes than the treatment of earnings-related pensions in payment, as they affect not only the evolution of the value of benefits during retirement, but also the starting value at the time of retirement (Whitehouse 2009). With wage growth typically exceeding inflation, pure price indexing would imply declining replacement rates which might be undesirable from a social perspective. For this reason, indexation policies in several countries with basic flat-rate schemes take earnings growth into account, although specific practices differ across countries. The UK minimum 2.5 percent lock is an outlier compared to other countries' indexation policies.

"Tier 1" Pensions: Indexation Policies

	Basic	Minimum	Safety-net
Australia	Highest of prices or cost of living		Highest of prices or cost of living
Austria			Discretionary
Belgium		Prices	Prices
Canada	Prices		Prices
Chile	Prices		Prices
Czech Republic	33.3% wages/66.7% prices	33.3% wages/66.7% prices	33.3% wages/66.7% prices
Denmark	Wages		Wages
Estonia	80% wages/20% prices		80% wages/20% prices
Finland	Prices		Prices
France		Prices	Prices
Germany			Wages
Greece	Prices		Prices
Hungary		Prices and net average monthly earnings	Prices and net average monthly earnings
Iceland	Highest of wages or cost of living		Prices
Ireland	Wages		Wages
Israel	Prices		Prices
Italy		Prices	Prices
Japan	Wages until age 67, then prices		Cost of living and wages
Korea			Prices
Luxembourg	Cost of living and annually consider wages	Cost of living and annually consider wages	Cost of living and annually consider wages
Mexico		Prices	Prices
Netherlands	Legal minimum wage		Legal minimum wage
New Zealand	Prices and periodically net average wage		Prices and periodically net average wage
Norway	Wages minus 0.75%		Wages minus 0.75%
Poland		Prices	Prices
Portugal		GDP and consumer price index without housing	Prices
Slovak Republic			Prices
Slovenia		60% wages/40% prices	
Spain		Between 0.25% and (consumer price index + 0.5%)	At least equal to contributory pension increase
Sweden	Prices		Prices
Switzerland			50% wages/50% prices
Turkey		Prices	Prices
United Kingdom	**Highest of prices, wages or 2.5%**		**Highest of prices, wages or 2.5%**
United States			Prices

Source: OECD Pensions at a Glance (2015)

17. Public spending on pensioner benefits is projected to increase significantly over the medium to long term. Spending on pensioner specific benefits are projected to remain broadly stable around five percent of GDP until the late 2020s.[20] Thereafter, increases in population above pensionable age and the impact of the triple lock indexation result in a significant increase in pension benefit spending of about 1.7 percent of GDP by FY2067. On the other hand, gross public service pension expenditure (i.e. before offsetting member contributions) is projected to fall from 2 percent of GDP in FY2017 to 1.3 per cent of GDP in FY2067. In particular,

- An ageing population puts significant pressure on pension affordability. Arrangements such as the state pension, which is a benefit rather than a contractual obligation for the government, and unfunded public sector pension schemes have generally worked on the basis that pension contributions from the current workforce pay for the pensions received by the previous workforce. However, as the population of the UK has aged, the ratio of people in retirement compared with those in work has risen. This trend is expected to continue over the next 40 years, which will further increase the proportion of pension payments made to pensioners relative to contributions received from those in work. The pressure on state pension spending from the ageing population is being tempered by increases in the State Pension Age. Between 2016 and 2020 the proportion of the population that is of pensionable age is projected to fall to 18 percent, as the SPA for men and women rises to age 66 by October 2020. Thereafter the proportion of the population of pensionable age is forecast to rise, reaching 19 percent in 2026 and climbing further during the subsequent decade.

- The contribution from the **triple lock indexation** is notorious: if pensions were to grow in line with average earnings instead, the expenditure pressure would reduce in half (raising by about 0.8 percent of GDP instead). In the OBR projection, the effect of the triple lock over the projection period is assumed to be equivalent to earnings growth plus about 0.35 percent a year. This figure is calculated as the average additional uprating each year if the triple lock had been applied rather than earnings from 1991 to the end of the medium-term forecast in early 2020s. Applying the same calculation for other advanced economies suggest that the estimated triple lock premium is rarely much lower than that estimated for the UK, and potentially significantly larger.[21]

- **Public service pensions** play a mitigating role, reflecting to a large extent reforms introduced since 2010 and the reductions to the public sector workforce associated with ongoing cuts to departmental spending.[22] The number of public sector employees has fallen by around

[20] Benefits include the state pension, pension credit, and winter fuel payments.

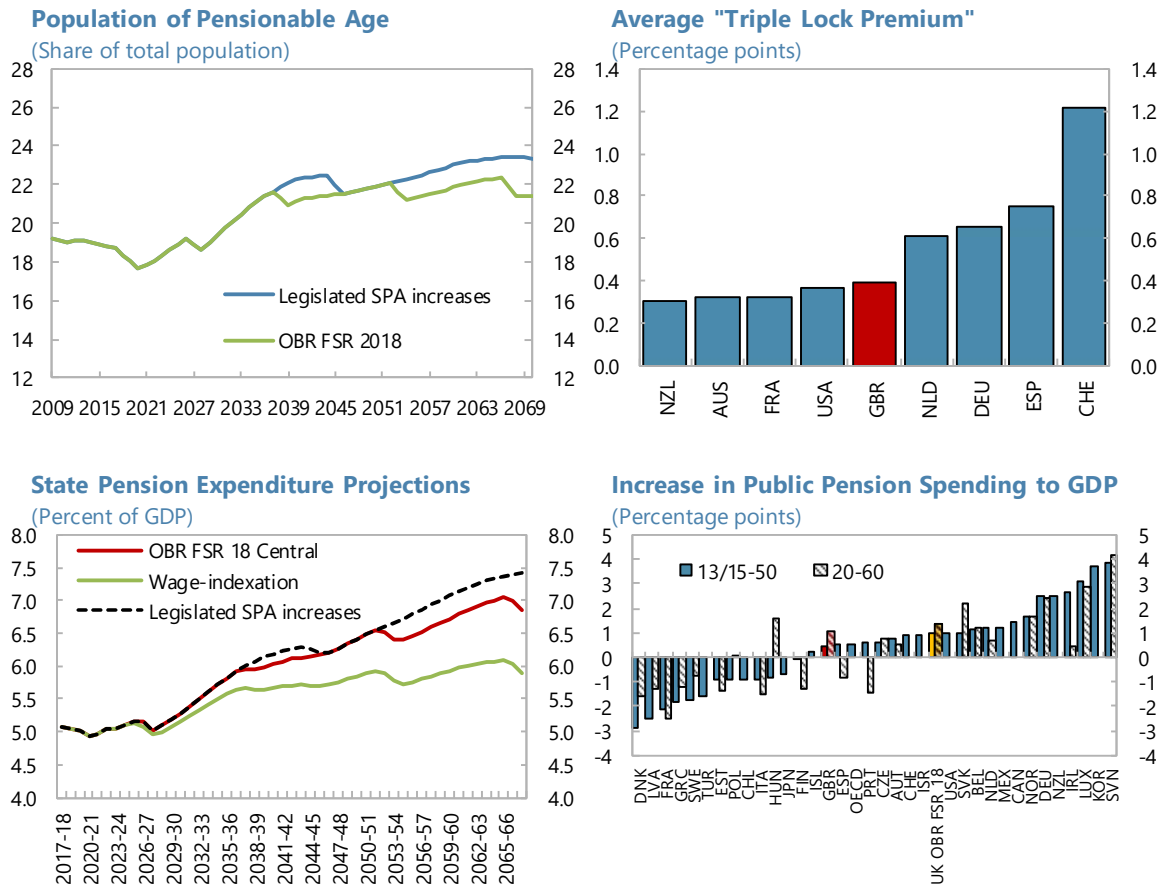
[21] Calculations for countries other than the UK is for reference and does not mean those countries use triple lock indexation. See Box 2 for a survey of actual indexation policies.

[22] Recent reforms include: increasing employee contributions (in 2015–16 the standard contribution rates increased for a number of schemes, including NHS, teachers and local government); uprating payments to public service

(continued)

15 percent from 6.3 million to 5.4 million between 2009–10 and 2014–15 (NAO 2017). This increases pension costs in the short term as member contributions as a proportion of public sector pensions paid will fall. In the longer term, however, this reduction in the public workforce will mean fewer people claiming a public sector pension in the future thereby reducing the cost of public sector pensions overall.[23]

Figure 8. Pension Benefit Spending Pressures



Sources: Haver Analytics; IFS 2017; OBR FSR 2018; OECD Pensions at a Glance 2017; ONS principal projection base-2016; and IMF staff calculations.
Note: Bottom left chart shows OBR projections, and bottom right chart shows OECD projections.
SPA = State Pension Age. Legislated policy is that the SPA for both men and women will increase to 67 between 2026 and 2028 and to 68 between 2044 and 2046. The OBR FSR 2018 assumed that the SPA increase to 68 would be brought forward to 2039, and further to 69 and 70 in 2054 and 2068, respectively. "Triple lock premium" estimated as the average difference between: (i) the maximum of earnings growth, CPI inflation, and 2.5 percent, and (ii) earnings growth, over the period 1990-2016. This should not be interpreted as a means of indexation for public pensions for countries other than the UK. Earnings growth based on average hourly/weekly/monthly earnings depending on data availability. See Box 2 for a survey of actual indexation policies.

pensions with CPI instead of the typically higher RPI; and amending scheme benefits in line with the Public Service Pensions Act 2013 (including linking pension age to the state pension age).

[23] Unfunded public pension schemes expenditures net of member contributions move broadly in line with gross public service pension expenditure (NAO 2016).

C. Policy Discussion

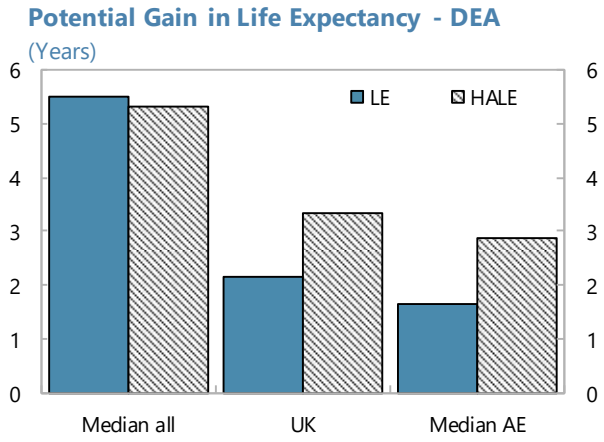
18. While the projected long run increases in health and pension spending going forwards are not unprecedented, they pose a challenge for public finances. It would certainly not be possible to fund such an increase in spending simply through higher government borrowing (IFS 2017). The OBR projections in the 2018 FSR illustrate that such additional borrowing would push debt onto an unsustainable trajectory. The UK will essentially have three options: rein in spending on these areas or be less ambitious in terms of what to expect, cut spending elsewhere, or increase revenues to finance the larger size of the state.[24]

Reining in Pressures in Health and Pensions

Health

19. Attaining a sustainable health care system over the long run will require reform, not without making difficult decisions.

- **Efficiency gains.** Continuously seeking the best value for money in public spending could ease fiscal pressures without reducing the quality of public services. The multi-year NHS funding plan announced in June is subject to a NHS 10-year plan. The government has set the NHS 5 financial tests for the plan, one of which is on improving productivity and efficiency (further details will be published in the plan). High level analysis based on cross-country data suggests there is room for improvement: potential gains in public health expenditure efficiency are below the median for overall sample, but above the median for advanced economies (see Annex 1 for empirical analysis).[25]

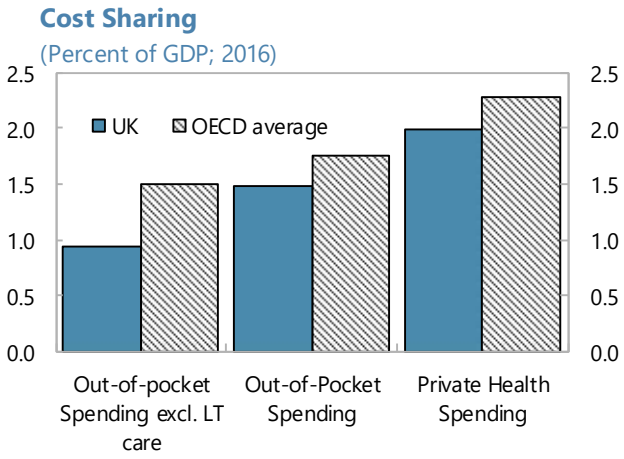


Source: Eurostat, WDI database, WHO database, and IMF staff calculations.
Note: LE= Life expectancy; HALE = Health-adjusted life expectancy. Potential gain in LE/HALE is computed using Data Envolpe Analysis (DEA).

[24] The expectations on what to expect from the care system are quite ambitious in certain areas. As an illustration, significant public debate has revolved in recent years around waiting times targets being missed, although in an international context, waiting times for treatment in the UK appear to be roughly average, compared with those in similar countries (Dayan and others, 2018).

[25] Along these lines, Dayan et al 2018 suggest that the UK performs less well than similar countries on the overall rate at which people die when successful medical care could have saved their lives. Although the gap has closed over the last decade for stroke and several forms of cancer, the mortality rate in the UK among people treated for some of the biggest causes of death, including cancer, heart attacks and stroke, is higher than average among comparable countries.

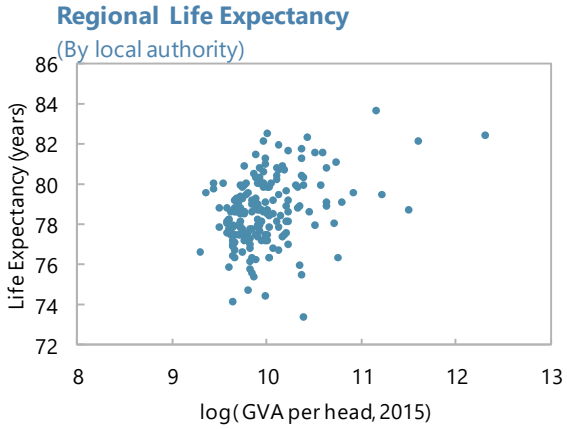
- **Cost sharing and out-of-pocket payments.** In the UK care system there are limited cost-sharing arrangements for publicly covered services. Out-patient prescription drugs (England), optical, and dental services are subject to co-payments.[26] Out-of-pocket payments and total private health spending as a share of GDP are lower in the UK compared to the mean for OECD countries. This suggests that higher cost-sharing through user fees could be considered.[27] User charges (e.g. for appointment to general practitioners, such as in New Zealand and Sweden) could deter overuse (e.g. missed appointments), although it also risks deterring appropriate use, possibly resulting in delays in treatment associated with higher costs or negative consequences on others (e.g. spread of a contagious diseases). For this reason, while most countries rely on user charges to some extent, in most European and OECD countries, these charges make up only a small portion of expenditure compared to developing countries (King's Fund, 2017). Within the current framework of exemptions in the UK, the age at which individuals become eligible for free prescriptions and eye tests has been kept at 60, while entitlements for most other financial and in-kind benefits have increased in line with the female state pension age (IFS and The Health Foundation, 2018).



Sources: OECD Health Statistics 2018; and IMF staff calculations
Note: Private health spending includes voluntary schemes and out of pocket current expenditures on health.

Pensions

20. The cost of a more generous state pension can be partly offset with increases in pensionable age. The OBR central projection already goes beyond the legislated increases in state pension age, reducing the increase in state pension expenditures by 25 percent (i.e. 2.3 versus 1.8 percentage points from FY17 to FY67).[28] While further increases in the state



Sources: ONS; and IMF staff calculations.

[26] Wales, Scotland, and Northern Ireland have abolished prescription charging.

[27] There is a wide-range of exemptions for co-payments, typically including people aged under 16 or over 60, people with chronic conditions, and people with low incomes.

[28] In line with the government's announcement, the central projection assumes that the currently legislated SPA increase to 68 would be brought forward from 2046 to 2039. Additionally, the central projection applies a *longevity link* to change the SPA profile consistent with the core principle announced by the Coalition Government in Autumn

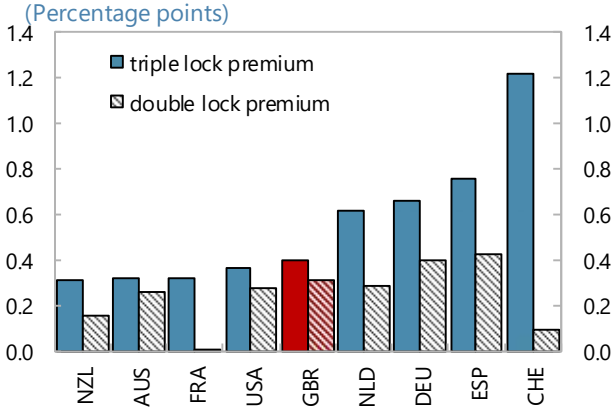
(continued)

pension age will likely be required as increases in life expectancy continue, it is important to note it may disproportionately affect certain groups of society with lower life expectancy than average. For instance, there are significant geographical differences in life expectancy. There are also significant differences in life expectancy by local deprivation levels and socio-economic group (Independent review of the State Pension age: interim report, 2016). As a result, relying solely on increases in state pension age is not the appropriate mechanism for ensuring the fiscal sustainability of the state pension.

21. Triple-lock indexation is an unsustainable method of indexation over the long term that will require reform. Because the state pension grows in line with the highest of earnings, prices and 2.5 percent in the long run it will increase faster than all of them. In the absence of reform, the state pension would account for an ever-greater share of national income (the so-called 'ratchet effect'). Alternatives to improve the sustainability of state pensions include:

- Moving to a **double-lock** indexation system (i.e. state pension would be increased over time in line with the highest of average earnings growth or inflation) does little to improve long-run state pension affordability.[29] This stems from the fact that it is rare in the UK for both average earnings and prices to grow below 2.5 percent. With double-lock indexation, spending on the state pension would still increase by a high 1.6 percent of national income by FY2066 (as opposed to 1.8 percent with the triple-lock), with over 40 percent of this increase being explained by the double-lock (relative to increasing in line with average earnings). Moreover, as with the triple lock, a double lock indexation of the state pension would still be subject to the so-called ratchet effect, meaning that pension payments would rise faster than earnings or prices over the long run.

Triple and Double Lock Premia
(Percentage points)



Sources: Haver Analytics; OBR FSR 2017; and IMF staff calculations.
Note: Double-lock premium estimated as the average difference between (i) the maximum of earnings growth and CPI inflation, and (ii) earning growth, over the period 1990-2016. This should not be interpreted as a means of indexation for public pensions for countries other than the UK. See Box 2 for a survey of actual indexation policies.

- Alternatives include **average earnings or inflation indexation**, or the so-called **smoothed earnings link** (IFS 2015, Work and Pensions Select Committee 2017). As opposed to the first two, the latter guarantees that the state pension never falls in real terms, and rises in line with

Statement 2013, that an individual should spend, on average, 'up to one third of their adult life' (beginning from age 20) over the State Pension age. In 2017 the government committed to 'up to 32 per cent' as the proportion of adult life people should expect to spend in receipt of state pension. This implies further rises in the SPA to 69 by 2054, and to 70 by 2068.

[29] The 2017 Conservative manifesto favored this option from 2020 onwards.

earnings growth over the long run. With the smoothed earnings link, the state pension would be uprated with earnings, but with temporary price-indexation when inflation exceeded wage growth. Price indexation would continue once earnings growth again exceeded inflation, but only for as long as the value of the state pension remained above an original fixed minimum proportion of average earnings. Indexation would then revert to earnings.

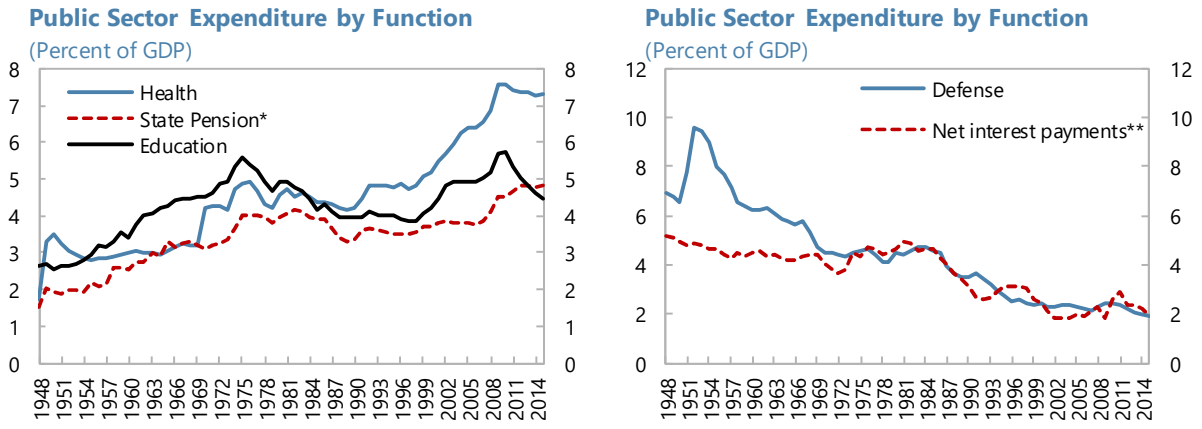
- **Simple discretionary increases in generosity** could also be used to raise the level of the state pension relative to earnings for the long term instead of the 'triple lock.' If the government wants to increase the level of the state pension relative to earnings, it could choose the level it wants (and potentially a path to get there) rather than following the triple lock, which leads to a totally arbitrary level of the state pension. Under the 'triple lock,' the value of the state pension in the long term depends not only on long-term inflation and increases in average wages, but also on the volatility of wage growth and inflation (and the correlation between them).

- **Means testing for access to social benefits in old age** could also be used to improve sustainability. Giving less pension to the wealthiest retirees could free-up resources to finance general benefits. At the same time, similar redistribution objectives could be pursued by using the tax system (e.g. by increasing the tax burden relatively more on better-off pensioners), while preserving a simple and clear structure for state pensions.

Cutting Spending in Other Areas

22. Alternatively, increases in spending on pensions, health and long-term care could be partly paid for by reducing spending elsewhere, but such cuts would likely be harder to achieve than they were historically. The projected increases in spending on health and pensions are not out of line with UK history (IFS 2017 and Figure 9). Over the last 35 years, spending in health and pensions increased by 5 percent of GDP, but it was largely offset by a reduction in expenditures in other areas, such as in defense, and interest payments. Going forward, interest payments are only likely to increase in line with monetary policy normalization, and the scope for further reductions in other areas may be limited following several years of consolidation, and the need to invest in human and physical capital to boost productivity (UK Article IV 2017). The forthcoming Spending Review will provide a good opportunity to re-assess the scope for efficiency gains to enable further reductions in other areas without reducing the quality or quantity of public services may be limited following several years of consolidation, and to re-prioritize public spending as needed.

Figure 9. Public Sector Expenditures by Function



Sources: BoE Millenium of macroeconomic data for the UK Database; DWP Benefit Expenditures Table; OBR databank; Haver Analytics; and IMF staff calculations.
Note: Education, health, and defense include both current and capital expenditures. * Pension spending is for Great Britain only, includes state pension plus winter fuel payments. ** Net interest payments excludes the temporary effects of financial sector interventions.

Raising Additional Revenues

23. In many areas, identifying further efficiency gains without reducing the quality of services could become more difficult, highlighting the need for additional revenue measures. While the tax burden is at the highest level in three decades, the UK still has a low tax environment from a cross-country perspective. General government revenues could be increased by 5 percent of GDP and still remain in line with the average for advanced economies (Figure 10).

- Certain tax reforms can reduce economic distortions and increase fiscal room (see IMF UK Staff Report 2017, 2018). Scaling back distortionary tax expenditures (such as removing preferential VAT rates on some goods) could improve efficiency, increase tax neutrality, and reduce pressure to cut more productive public spending.[30] More broadly, transparency would be enhanced if tax expenditures were embedded in decision making on the overall spending envelope, making it easier to assess whether the tax expenditure schemes can be justified on an ongoing basis as compared to other policy instruments (IMF 2016 UK Fiscal Transparency Evaluation Rec. 1.2).[31] Moving towards a more equal tax treatment of employees, the self-employed, and corporations would improve fairness and reduce incentives to switch to a different legal form of work for tax reasons (any differences in tax treatment should be aligned with differences in benefit entitlements). It would also bring the tax system in line with evolving employment practices.

[30] Tax relief on value added taxes represents the largest category by tax expenditures cost (2.5 percent of GDP), with the main contribution given by the zero percent VAT rate on most foods (0.9 percent of GDP).

[31] Along these lines, the Resolution Foundation (2018) has criticized that "*too often tax reliefs, even when very expensive and poorly designed, go unexamined when decisions are taken on ways to raise tax revenues,*" citing for example the Entrepreneurs' Tax Relief, which is described as expensive, ineffective and regressive.

- Given the scale of revenues that would need to be raised over the long term, raising one of the three main taxes would likely be required (IFS and Health Foundation 2018). Value added taxes (VAT), personal income tax (PIT), and national insurance contributions (NIC) together account for about two thirds of government revenues, and have a broad base. Instead, focusing on taxes that raise little revenue or are paid by relatively few individuals would require significant increases. Moreover, the OBR Fiscal Risk Report (2017) has highlighted the risks associated with the concentration of tax receipts among a small number of taxpayers.[32] For instance, income tax (the largest source of government revenue) has become more concentrated over the past decade, as a result of policy changes that have lowered the proportion of adults paying income tax, and raised the share paid by high earners among taxpayers. The Conservative manifesto has pledged not to increase the level of VAT, and this tax is the least progressive of the three main taxes. Both NICs and PIT are progressive, but with important differences: increasing PIT rather than NICs would mean a tax increase for pensioners and others reliant on unearned income, as well as for those with labor market earnings.[33, 34]

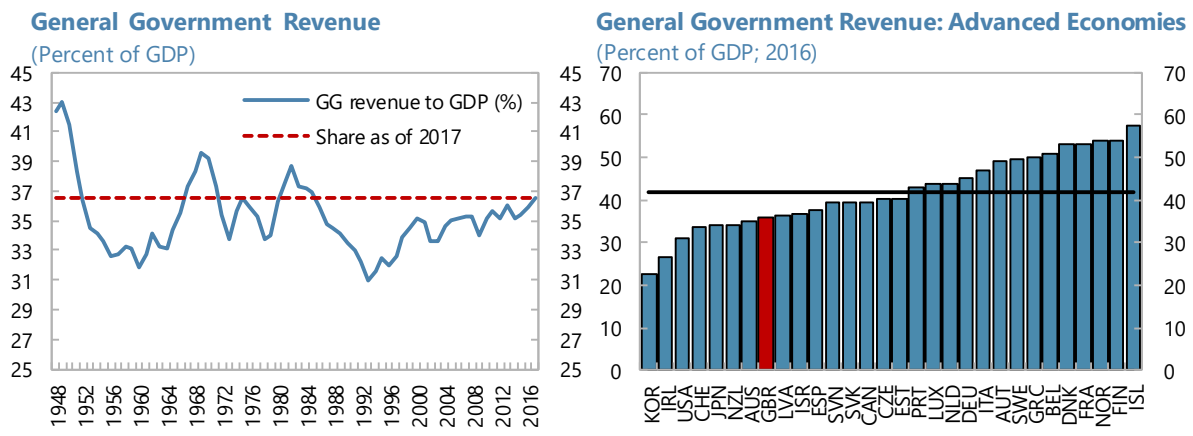
- Corporation taxes account for the fourth largest source of revenues. The corporation tax has been cut repeatedly since 2010, with an additional cut from 19 to 17 percent planned for April 2020. At the current rate (19 percent) the UK already has one of the lowest headline corporate tax rates in the G20 and, although this is somewhat offset by a relatively broader tax base, it still has one of the most generous corporate tax systems among advanced economies on more comprehensive measures (see IFS 2017, and Devereux and others 2016).

[32] Greater concentration is likely to increase the sensitivity of the tax system to downturns and the susceptibility of tax receipts to idiosyncratic shocks affecting the key taxpayers (OBR 2017).

[33] Not only are NICs only payable on employment income, but employees cease to pay NICs when they reach the state pension age. As a result, under current rules, the burden of increased NICs falls solely on individuals of working age. Another alternative would be to increase taxation on the elderly (for instance, by extending NICs to the earnings of those above the state pension age), who have fared well relative to the rest of the population over the last decade (see above) and particularly benefit from any increases in NHS spending (see Resolution Foundation 2018, and IFS and Health Foundation 2018).

[34] The *basic* or *higher* rates of income tax have not been raised since the 1970s, while an *additional* rate of income tax (for all income above £150k) was introduced in 2010. Increases of NIC rates have been implemented in the early 1990s, early 2000s, and early 2010s (IFS 2017). The standard rate of VAT was raised from 17.5 percent to 20 percent in 2011.

Figure 10. Tax Burden



Sources: Haver Analytics; IMF Fiscal Monitor 2018; ONS; and IMF staff calculations.

24. An explicit earmarking of tax increases for health spending has been raised as an option in the domestic policy debate.[35] Linking a tax increase to the need to fund health expenditures could make the tax increase more palatable: a British Social Attitudes survey last year showed that around 60 percent of respondent supported tax rises to increase funding for the NHS (up 20 percentage points from 2014).[36] However, hard-earmarking is not advisable.[37] From a public financial management perspective, hard earmarking makes the budget more rigid, limiting reallocations or fiscal adjustment. Moreover, such an arrangement could potentially result in health expenditures with excessive volatility, procyclicality, and, more structurally, a revenue head that may struggle to grow in line with spending pressures.

D. Conclusion

25. Spending pressures related to population aging will pose a significant challenge to the public finances in a context of already relatively high public indebtedness. If these pressures are left unaddressed, additional borrowing would put debt in an unsustainable path (OBR FSR 2018). Preserving fiscal sustainability will there require difficult social choices going forward. Opportunities for further efficiency gains in the NHS should be explored, and the elimination of the triple-lock could lead to important savings over time on state pensions. More broadly, absent a fundamental rethinking of the size and role of the public sector, revenue measures will need to play a more prominent role. Indeed, a higher reliance on taxes would be a natural consequence of population aging under the current model that funds health and pension spending mostly via general taxation.

[35] Revenues from NICs are not earmarked and contribute to general government revenues in the same way as income tax.

[36] Hypothecated taxes are used to finance public health expenditures in countries such as Australia, Denmark, France, Germany, and the Netherlands.

[37] Earmarking of revenue and standing expenditure commitments are limited in the UK (IMF 2014). This is in line with the principle of budget unity/universality, where the budget should be able to consider all spending and revenue decisions equally, implying that all revenues should go into the one fund to finance government activities.

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Annex I. Assessing the Efficiency of Health Expenditure

Methodology and Data

This section studies the efficiency of public sector spending in the UK, by analyzing the relationship between spending inputs and health outcomes relative to other countries. The analysis uses two types of methodologies:

- **Non-parametric model.** The Data Envelope Analysis (DEA) technique identifies a production frontier from the best performers by level of spending (see for instance Gupta and others, 2007, and Joumard, André, and Nicq, 2010). The distance of countries to the frontier is the measure of their inefficiency (i.e. how they could improve health outcomes without increasing spending).

- **Parametric model.** Under Stochastic Frontier Analysis (SFA), regression analysis is used to estimate the production frontier, and the efficiency of spending is measured using the residuals from the equation (see for instance Grigoli and Kapsoli, 2013, and Beidas-Strom, 2017). The estimation requires the specification of a distribution for the "efficiency" term (μ_i). The analysis considers both half normal and exponential distributions.

$$\log(LE_i) = \alpha + \sum_j \beta_j \log(X_{ji}) + \varepsilon_i - \mu_i$$

The major advantage of nonparametric techniques is that no assumption is made about the functional form of the relationship between spending inputs and outputs. The drawback is that the frontier is formed by the outliers that establish "best practices," with a large risk of measurement error. The parametric model is more robust to outliers, but as a disadvantage, a functional form of the relationship between spending inputs and outputs must be assumed.

The analysis is conducted using data for 178 advanced, emerging, and low-income economies, for the period 2010–2015.[1]

- The key input variable of interest is public health expenditure per capita (PPP-adjusted). Health outcomes are measured by life expectancy at birth. A caveat is that health spending not only aims to prolong life, but also to improve the quality of life—for example, by relieving chronic pain or addressing problems with mobility. To (partly) capture this, the exercise also considers alternative measures, such as health adjusted life expectancy at birth (HALE) and amenable mortality.[2]

[1] Health expenditure series for the UK in the database have a break in 2013, so these variables are averaged over the period 2013–2015 instead.

[2] HALE estimates the number of healthy years an individual is expected to live at birth by subtracting a proportion of the years of ill health (weighted according to severity) from overall life expectancy. A death is considered as amenable if it could have been avoided through optimal quality health care (see Eurostat).

- Amenable mortality is measured using the Healthcare Care Access and Quality Index (see GBD 2015 Healthcare Access and Quality Collaborators, 2017). The index ranges from 0 (worst) to 100 (best), and focuses on a list of causes from which death should not occur with timely and effective medical care. Moreover, the index is obtained after risk-standardization to eliminate geographical differences in cause-specific mortality due to variations in risk factors that are not immediately targeted by health care systems. This helps isolate variations in death rates due to health care access and quality from other drivers such as differences in risk factor exposure (e.g. diet, high BMI, and physical activity).

- Data is obtained from the World Development Indicators Database, the World Health Organization Database, Eurostat, and GBD 2015 Healthcare Access and Quality Collaborators (2017). Health outcomes are determined by many factors beyond spending on health care, so different specifications control for several socio-economic, natural endowment and behavioral characteristics.

- Data on "secondary completion rate" are missing in the database for several countries, including Canada, Japan, Netherlands, New Zealand, Portugal, Singapore, United States and South Africa. However, these countries do have data for other education variables (e.g. educational attainment at the lower secondary and primary level), which tend to be highly correlated. In those cases, the predicted value is assigned based on simple regressions with available data.

Findings

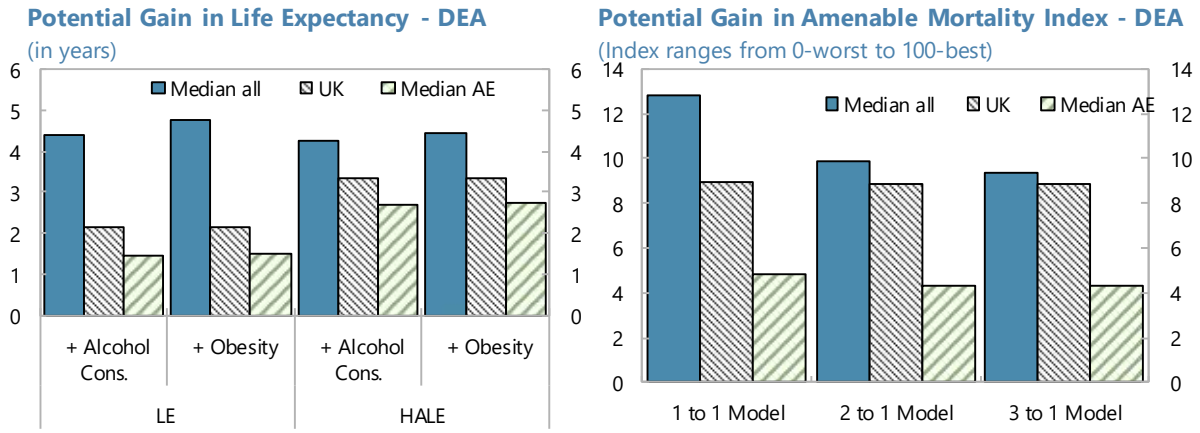
Results suggest there is room for improvement: potential gains in public health expenditure efficiency are below the median for overall sample, but above the median for advanced economies.

- **Non-parametric analysis**. The baseline DEA specification considers 1 input and 1 output. The UK could increase life expectancy and health-adjusted life expectancy by two to three years without increasing public sector health expenditure (see figure in main text).

- The results are robust to the including other inputs as additional controls (Annex Figure 1). In particular, the robustness exercise controls for secondary completion rates, and either alcohol consumption or obesity rates.

- Measuring health outcomes using amenable mortality rates delivers a similar message. Potential gains in the health care access and quality index without increasing public sector health expenditure (and other inputs) is higher for the UK than the median for Advanced Economies. Three versions are considered: 1 input (public health expenditure), 2 inputs (adds secondary completion rates), and 3 inputs (adds prevalence of tuberculosis). Alcohol consumption and obesity rates are not considered as controls, as the index is risk-standardized (i.e. it already controls for exposure to risk factors).

Figure 1. Health Expenditure Efficiency—Data Envelope Analysis



Sources: Eurostat; GBD 2015 Healthcare Access and Quality Collaborators (2017); WDI database; WHO database; and IMF staff calculations.
Note: LE= Life expectancy; HALE = Health-adjusted life expectancy. Potential gain in LE/HALE is computed using Data Envolpe Analysis with 3 input-1 output. Inputs include public health expenditures (PPP adjusted), secondary completion rates, and either alcohol consumption or obesity rates. Potential gains in amenable mortality index are estimated using Data Envolpe Analysis with 1 input (public health expenditure), 2 inputs (adds secondary completion rates), and 3 inputs (adds prevalence of tuberculosis).

- **Parametric analysis.** The baseline specification for SFA controls for educational attainment (secondary completion rate), access to clean water, alcohol consumption, obesity rates, incidence of tuberculosis, and population density. Estimated coefficients are intuitive: life expectancy is increasing in public health expenditures, educational attainment, access to clean water, and population density, and decreasing in alcohol consumption, obesity rates, and the incidence of tuberculosis.[3]

- In line with the DEA results, the analysis suggests the UK lies below the efficiency frontier, indicating that the same HALE scores could be attained by spending less (Annex Figure 2). Life expectancy and health-adjusted life expectancy could be increased by two to three years without increasing public sector health expenditure.

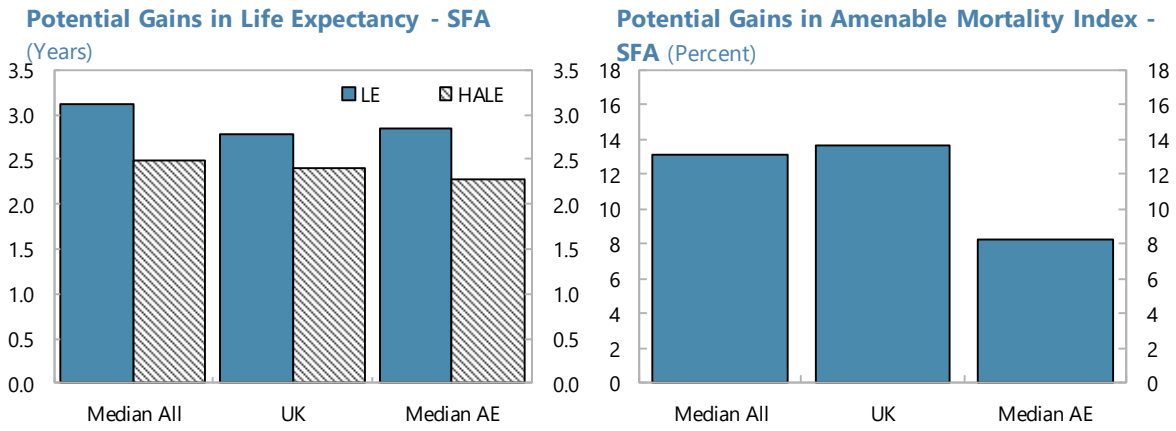
- Results are generally robust to the inclusion of additional controls, such as: smoking rates, share of population aged 65 plus, private health expenditures per capita (PPP-adjusted), access to sanitation facilities, annual temperatures, and precipitation, and universal health coverage index.

- The specification for amenable mortality index (measured by the Healthcare Care Access and Quality Index) excludes alcohol consumption and obesity rates as controls, as the index is risk-standardized (i.e. it already controls for exposure to risk factors). In line with the DEA results,

[3] The quantity and quality of public health services is usually easier to carry out in areas that are urban or more densely populated since commuting distances are shorter and the diffusion or transfer of knowledge and innovation is faster and competition brisker than in rural areas (Beidas-Strom, 2017).

when using this dependent variable that seeks to isolate variations in death rates due to health care access and quality from other drivers, the potential gains for the UK become closer to those of the median for the full sample (and above those for the median advanced economy).[4]

Figure 2. Health Expenditure Efficiency—Stochastic Frontier Analysis



Sources: Eurostat; GBD 2015 Healthcare Access and Quality Collaborators (2017); WDI database; WHO database; and IMF staff calculations.
Note: LE = Life expectancy; HALE = Health-adjusted life expectancy. Potential gain in LE/HALE is computed using Stochastic Frontier Analysis (SFA) – see main text for baseline specification. Results shown in the chart are computed using the simple average of the estimates obtained assuming a half normal or an exponential distribution for the efficiency term.

Dependent Variable: HALE at Birth		
VARIABLES	Half Normal	Exponential
logHE_pub	0.028***	0.029***
	(0.000)	(0.000)
logEducSec	0.066***	0.066***
	(0.000)	(0.000)
logWater	0.051***	0.049***
	(0.000)	(0.001)
logObesity	-0.018***	-0.018***
	(0.009)	(0.002)
logAlcohol	-0.007**	-0.005
	(0.032)	(0.134)
logTuberculosis	-0.021***	-0.018***
	(0.000)	(0.000)
logPopDens	0.005*	0.005*
	(0.080)	(0.060)
Constant	3.654***	3.630***
	(0.000)	(0.000)
Observations	168	168
pval in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

Dependent Variable: HAQ		
VARIABLES	Half Normal	Exponential
logHE_pub	0.085***	0.090***
	(0.000)	(0.000)
logEducSec	0.163***	0.154***
	(0.000)	(0.000)
logWater	0.208***	0.215***
	(0.000)	(0.000)
logTuberculosis	-0.038***	-0.031***
	(0.000)	(0.001)
logPopDens	0.018***	0.015***
	(0.001)	(0.005)
Constant	2.184***	2.113***
	(0.000)	(0.000)
Observations	172	172
pval in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

[4] Both the DEA and the SFA results for the amenable mortality index correlate positively (0.68 and 0.7 respectively) with the distance to the efficiency frontier estimated by GBD 2015 Healthcare Access and Quality Collaborators (2017). However, it should be noted that the exercise in this reference does not control for health expenditure.

Dependent Variable: Life Expectancy at Birth

VARIABLES	Half Normal	Half Normal	Half Normal	Half Normal	Half Normal	Half Normal	Half Normal	Half Normal	Half Normal	Half Normal	Exponential	Exponential	Exponential	Exponential	Exponential	Exponential	Exponential	Exponential	Exponential	Exponential
logHE_pub	0.029***	0.035***	0.025***	0.029***	0.028***	0.029***	0.029***	0.032***	0.029***	0.027***	0.030***	0.025***	0.026***	0.028***	0.029***	0.029***	0.027***	0.030***	0.027***	0.017***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
logEducSec	0.063***	0.031***	0.063***	0.062***	0.060***	0.063***	0.062***	0.073***	0.062***	0.038***	0.061***	0.033**	0.058***	0.061***	0.057***	0.062***	0.066***	0.070***	0.066***	0.032**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.025)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.023)
logWater	0.034***	0.044***	0.027*	0.034**	0.018	0.034**	0.031**	0.012	0.032**	0.012***	0.037**	0.105***	0.029*	0.033**	0.014	0.035**	0.033**	0.019	0.034**	0.051**
	(0.010)	(0.000)	(0.092)	(0.014)	(0.398)	(0.018)	(0.020)	(0.485)	(0.015)	(0.000)	(0.015)	(0.000)	(0.057)	(0.038)	(0.516)	(0.025)	(0.022)	(0.219)	(0.022)	(0.043)
logObesity	-0.015**	-0.020***	-0.016**	-0.015**	-0.018**	-0.016**	-0.012**	-0.013**	-0.013**	-0.012***	-0.016***	-0.019***	-0.015**	-0.015**	-0.018***	-0.017***	-0.013**	-0.012*	-0.014**	-0.016***
	(0.015)	(0.000)	(0.019)	(0.019)	(0.010)	(0.016)	(0.041)	(0.040)	(0.018)	(0.000)	(0.008)	(0.001)	(0.014)	(0.010)	(0.004)	(0.007)	(0.029)	(0.052)	(0.024)	(0.008)
logAlcohol	-0.009**	-0.020***	-0.014***	-0.010**	-0.009**	-0.009**	-0.010**	-0.015***	-0.010**	-0.014***	-0.005	-0.001	-0.011***	-0.006	-0.005	-0.005	-0.006	-0.011***	-0.006	-0.007**
	(0.017)	(0.000)	(0.000)	(0.019)	(0.025)	(0.018)	(0.013)	(0.000)	(0.014)	(0.000)	(0.126)	(0.864)	(0.003)	(0.103)	(0.151)	(0.135)	(0.126)	(0.003)	(0.119)	(0.047)
logTuberculosis	-0.023***	-0.023***	-0.020***	-0.022***	-0.023***	-0.022***	-0.023***	-0.024***	-0.024***	-0.020***	-0.020***	-0.022***	-0.017***	-0.019***	-0.020***	-0.020***	-0.023***	-0.023***	-0.023***	-0.022***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
logPopDens	0.007**	0.009***	0.005*	0.007**	0.007**	0.007**	0.010***	0.008***	0.010***	0.010***	0.006**	0.008***	0.005**	0.006**	0.006**	0.006**	0.008***	0.007***	0.008***	0.007**
	(0.021)	(0.000)	(0.067)	(0.023)	(0.045)	(0.022)	(0.000)	(0.006)	(0.001)	(0.000)	(0.014)	(0.001)	(0.033)	(0.020)	(0.027)	(0.015)	(0.004)	(0.005)	(0.007)	(0.010)
logSmoking		-0.001***										-0.009								
		(0.000)										(0.316)								
log65plus			0.032***										0.029***							
			(0.000)										(0.000)							
logHE_priv				0.001										0.004						
				(0.789)										(0.371)						
logSanitation					0.013										0.018					
					(0.263)										(0.146)					
logUrbanPop						0.002										0.004				
						(0.853)										(0.654)				
annual_temp							0.001										0.000			
							(0.305)										(0.544)			
logPrecip								0.014***										0.014***		
								(0.001)										(0.001)		
logTemp									0.007										0.005	
									(0.266)										(0.499)	
UHCcoverage										0.001***										0.002***
										(0.000)										(0.000)
Constant	3.844***	3.933***	3.841***	3.846***	3.887***	3.841***	3.844***	3.795***	3.832***	3.948***	3.815***	3.690***	3.822***	3.820***	3.867***	3.810***	3.816***	3.768***	3.805***	3.822***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	168	119	168	168	168	168	156	156	156	127	168	119	168	168	168	168	156	156	156	127

pval in parentheses

*** p<0.01, ** p<0.05, * p<0.1