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# Unravelling Deep Integration: Local Labour Market Effects of the Brexit Vote

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Single Market Economics Papers

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# Unravelling Deep Integration: Local Labour Market Effects of the Brexit Vote \*

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## Abstract

This paper uses high frequency data on the near universe of job adverts posted online in the UK to study the impact of the threat of trade barriers caused by the Brexit referendum on labour markets between January 2015 and December 2019. We develop measures of local labour market exposure to prospective trade barriers on both goods and services exports if the UK were to leave the EU without a trade deal. We find that regions that were more exposed to potential barriers on professional services exports to the EU experienced a significant relative decline in online job adverts in the period after the referendum, particularly for higher skilled jobs and professional and managerial occupations. This effect was distinct from the impact of the exchange rate depreciation, uncertainty surrounding future immigration policy and the threat of future barriers on trade in goods.

**Keywords:** services trade, tariffs, trade barriers, online job adverts, Brexit, local labour markets

**JEL classification:** F14, F15, F16

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# 1. Introduction

Decades of research in international economics have been devoted to understanding the consequences of trade barriers. While by now the effects of barriers on trade in goods are well understood, still relatively little is known about the impact of services trade barriers, despite the growing role of services trade and the increasing prevalence of deep trade agreements that include important provisions for services industries.<sup>1</sup> Examining the implications of services liberalization has been difficult because liberalization episodes often went hand in hand with other major policy changes (as was the case for the European Union (EU) enlargement), or the choice of liberalized industries was driven by endogenous factors, making it difficult to establish causality.

The Brexit referendum of 2016, which introduced the prospect of ‘unravelling’ decades worth of deep integration between the UK and the EU – the world’s most advanced services trading bloc – provides a rare opportunity to study the impact of barriers to services trade. Not only did the Brexit vote create the threat of sizable barriers to services exports, its outcome was largely unexpected and introduced plausibly exogenous variation in the extent of exposure to future barriers. Leaving the EU Single Market by the UK meant the UK becoming a third party to other EU & European Economic Area (EEA) countries and trade in services reverting to the terms set by individual member states under the GATS.<sup>2</sup> Reverting to GATS terms represented a major shift in services trade policy for many UK services industries, although the extent of the shift depended on the regulatory ‘gap’ between services trade restrictions while the UK was in the EU and the specific GATS terms for each industry in each export destination. Services accounted for 81 percent of UK economic output and 46 percent of exports in 2018 (ONS, 2019) and so this shift in services trade policy had economy-wide implications.

This paper focuses on labour market effects and examines how the threat of trade barriers introduced by the Brexit referendum affected the posting of online job adverts over the

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<sup>1</sup>Deep integration typically refers to economic integration that goes beyond trade to include freer movement of goods, services, capital, people and ideas. It is typically achieved through a Deep Trade Agreement (DTA) where DTAs are preferential trade agreements that cover not just trade but also additional policy areas, such as international flows of investment or protection of intellectual property rights (Mattoo et al., 2020).

<sup>2</sup>The EU’s Single Market is an area that seeks to guarantee the free movement of goods, capital, services, and labour within the EU. It encompasses the EU’s 27 member states plus Iceland, Liechtenstein and Norway through the Agreement on the EEA and Switzerland through bilateral treaties.

full referendum and negotiation period between January 2015 and December 2019. A high frequency dataset, capturing the near universe of online job adverts in the UK at a granular geographic level, allows us to document the immediate responses to the referendum outcome and the resulting prospects of future barriers to exports. Our analysis approaches this question from the perspective of the UK's 213 local labour markets, defined as 'Travel to Work Areas' (TTWAs). While traditional labour market data sources for the UK provide data only on total employment on an annual basis for local labour markets, studying online job adverts allows us to capture the detailed time variation in responses to events throughout the negotiation period, and by detailed occupation and skill type. The local labour market perspective also allows us to examine potential spillover effects across localities.<sup>3</sup>

For each UK export destination and industry, we construct the regulatory 'gap' between the stringent restrictions UK exporters would face as a result of leaving the EU without a trade deal and hence reverting to GATS terms, and the minimal restrictions they faced while the UK was part of the EU. These are measured using the OECD's Services Trade Restrictiveness Index (STRI) and Intra-EEA STRI, respectively. We focus on professional services, which are the UK's major services export. UK industries were differentially exposed to future barriers depending on the pre-vote geographic composition of their exports to EEA countries and the extent of the regulatory 'gap' in the policy of their export partners, with the gap determined by GATS terms that were generally set during the WTO's Uruguay Round in 1995.

The Brexit referendum, of course, signalled far more than the threat of services trade barriers alone and so we also consider the impact of three other key channels: the threat of barriers to goods exports, immigration policy changes and the exchange rate depreciation. For goods exports, a no-deal scenario would have meant reverting from tariff-free trade to trade under the WTO terms, where the UK would have faced Most Favoured Nation (MFN) tariffs on its exports to the EU. We exploit the product-level variation in EU MFN tariffs to construct measures of the tariff threat for each manufacturing industry.<sup>4</sup> We measure pre-referendum exposure to prospective barriers on services and goods exports to the EU for

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<sup>3</sup>Online job adverts can relatively easily be classified by geographic area, but are harder to classify by industry, making industry-level analysis more noisy and less complete. For example, in the dataset used, less than half of job adverts are classified by industry.

<sup>4</sup>MFN terms are defined as follows: 'Under the WTO agreements, countries cannot normally discriminate between their trading partners. Grant someone a special favour (such as a lower customs duty rate for one of their products) and you have to do the same for all other WTO members.' More information can be found here: [https://www.wto.org/english/thewto\\_e/whatis\\_e/tif\\_e/fact2\\_e.htm](https://www.wto.org/english/thewto_e/whatis_e/tif_e/fact2_e.htm)

each local labour market. We then follow a difference-in-differences approach, comparing the posting of online job adverts in highly exposed localities to those in less exposed localities in the post-referendum period relative to the pre-referendum period, controlling for the impact of the exchange rate depreciation and exposure to immigration policy changes. We use this strategy in light of there being no evidence of differences in pretrends and given that the result of the Brexit referendum was largely unexpected.<sup>5</sup>

We find that regions that were *ex ante* more exposed to the threat of future trade barriers on professional services exports experienced a decline in online job postings after the referendum, relative to less exposed regions. The estimated decline is economically meaningful: a one-standard-deviation increase in exposure to potential future barriers leads to a 5 percent decrease in monthly job postings in our baseline specification, controlling for exposure to possible future tariffs, the impact of the exchange rate depreciation, and exposure to immigration from the EU. The effect is found for both low and high skill jobs, although the magnitude is much larger for the high skill category, with a particularly strong impact on postings for executives, managers and professional occupations. A back-of-the-envelope calculation suggests that approximately 1.5 million fewer job adverts were posted between June 2016 and December 2019 due to the threat of export barriers in services created by the referendum outcome. To put this figure into perspective, the size of the UK labour force is about 34 million. At an average monthly level, the decline was equivalent to 6.5 percent fewer job adverts.

An event study analysis points to two breaks in the relationship between the threat of barriers to services exports and online job postings. Job postings seemed to have first reacted to this threat starting in the quarter immediately following the invocation of Article 50 on the 29th of March 2017. This act represented the formal announcement of the UK's intention to withdraw from the EU. The second stark reaction of online job postings appears to be linked to the publication of the UK Government's Brexit White Paper on the 12th July 2018, in which the UK Government for the first time clearly spelled out its negotiating intentions, including its intention to leave the Single Market and hence accept a looser integration with the EU in services industries.

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<sup>5</sup>During the 24 hours following the Brexit referendum, sterling experienced its greatest one-day loss since the introduction of free-floating exchange rates in the 1970s, reflecting the adjustment of market expectations to the referendum outcome. Moreover, betting markets placed the odds of a 'leave' result at around 30 percent in the months leading up to the referendum (Graziano et al., 2018).

In contrast to the threat of services trade barriers, we find that the threat of future tariffs on goods exports and exposure to immigration policy changes did not have a statistically significant effect on job postings after the vote in our baseline specification. However, for export tariffs there are two exceptions: (i) when we explore the impacts on job adverts by occupation type, we find negative effects on postings for the occupation category corresponding to plant and machine operators, and (ii) we find evidence suggesting that tariffs do matter when we no longer focus only on job adverts in the same local labour market only but augment the analysis to also take into account a larger geographic area, studying effects in all other TTWAs weighted by inverse distance.

In contrast to tariffs, in the extension where we augment the analysis with an additional variable capturing exposure to Brexit-induced barriers in all other TTWAs weighted by the inverse distance, we do not find evidence of such spillovers for professional services barrier exposure. Finally, our baseline results are robust to various specifications including pre-vote placebo tests, excluding London from the analysis and measuring barrier exposure in various different ways. Moreover, we do not find evidence of effects of the threat of goods non-tariff barriers or import tariffs on job postings.

Job postings reflect only one element of the labour market response: firms' intention to hire new employees either to replace existing employees or for firm growth. Although detailed data on the other side of the coin, namely labour market outflows, are not available for local labour markets, national statistics on employment flows and job-to-job changes do not suggest a decline in the number of workers leaving or changing jobs after the Brexit vote and thus our findings appear unlikely to be explained by lower employment turnover.

Given the lack of detailed employment data for local labour markets, we use quarterly labour force survey data to shed some light on the relationship between the relative decline in online job postings and unemployment rates. We find that although impacts were somewhat volatile over the negotiation period, TTWAs that were more exposed to services barriers also saw a relative rise in unemployment rates at a time that closely matches the timing of the largest negative effect on online job adverts observed in the aftermath of the Brexit White Paper being published in July 2018. This provides some suggestive evidence that the decline in job adverts for more services barrier exposed localities did, to some degree, feed through to also affect relative employment outcomes.

The financial services sector received a lot of attention during the Brexit negotiation period because of its importance to the UK economy. In 2018, financial services alone accounted for 6.9 percent of UK GDP and 11.7 percent of all UK services exports (ONS, 2018). The issue of ‘passporting’ rights, which allow financial businesses authorised in any EU Member State to operate freely across the EEA, was central to the Brexit discussions as the loss of these rights was perceived as extremely damaging to many of the core business operations of financial firms based in the UK.<sup>6</sup> Therefore, in an extension we also focus specifically on the role of barriers to financial services exports. Using detailed data on regional exports that is available for financial services only, we document that the threat of barriers to exports of financial services exports to the EU played an important role in the decline in job postings.

Taken together, our results suggest that barriers to services trade can have important economic consequences in advanced economies that rely heavily on services trade and have pursued deep integration with their major trade partners, like the UK. The mere threat of the introduction of such barriers had substantial, and relatively overlooked, effects on UK labour markets during the Brexit negotiation period through the reduced advertising of job openings, particularly for highly skilled professional and managerial roles, which are generally seen as ‘good’ jobs. By contrast, despite the greater prominence of tariffs and goods supply chains in the public debate on the economic impacts of Brexit, the threat of tariffs on goods exports had only a minor impact on online job postings.

This research adds a number of new insights about the labour market impacts of the Brexit referendum and the threat of services trade barriers. First, we add new evidence to the knowledge base on the labour market effects of globalization. Although the literature on the impacts of trade on labour markets has expanded significantly over the past decade (for example, Autor et al. (2014), Pierce and Schott (2016) & Hummels et al. (2014)), this literature has generally focused on the impacts of goods trade, while services trade has received less research attention, perhaps due to the relative scarcity of data or detailed measurement on services trade and services trade barriers. In this paper, we demonstrate that the labour market consequences of services trade barriers can be also be sizable, with the mere threat of these barriers having economically important negative impacts on job postings, and in some cases these barriers may have greater consequences than those on goods trade.

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<sup>6</sup>For more information on passporting see <https://www.bankofengland.co.uk/prudential-regulation/authorisations/passporting>

Second, more broadly this research expands the knowledge base on the consequences of the internationalisation of services industries, contributing to a literature that stretches from examining the benefits of services liberalization for productivity of manufacturing firms (Arnold et al., 2011, 2016; Barone and Cingano, 2011; Beverelli et al., 2017; Breinlich et al., 2018) to the implications of services offshoring (Liu and Trefler, 2019; Crinò, 2010; Eppinger, 2019; Amiti and Wei, 2005) to the tradability of services (Jensen and Kletzer, 2005; Gervais and Jensen, 2019). By relying on the plausibly exogenous shock of the Brexit referendum, we are able to isolate the distinct impacts of services trade barriers from goods trade barriers and immigration policy, providing new evidence on the economically important, and often overlooked impact of services trade and services trade barriers, particularly in advanced, services-dependent economies. In addition, our research documents the importance of market access for services exports, in contrast to much of the existing literature on services trade, which has tended to place a greater focus on services imports.

Third, this research also adds new evidence to the emerging literature on the impacts of trade disintegration and loss of market access as opposed to trade integration or liberalization (e.g. Amiti et al. (2019), Cavallo et al. (2019), Fajgelbaum et al. (2019), Mayer et al. (2018)). The Brexit referendum introduced one of the most wide-ranging and stringent episodes of the prospective reversal of trade integration with a country's major trade partners to date, providing important lessons about the potential consequences of trade disintegration. We document that the threat of this reversal can have immediate and sizable economic consequences, and, in contrast to most existing work, demonstrate the important role of reversing market access for services trade as opposed to goods trade.

Given the Brexit referendum outcome introduced the *prospect* of trade barriers, as opposed to actual barriers themselves, we also contribute to the body of evidence on economic policy uncertainty (e.g. Bernanke (1983), Hassler (1996) and Bloom (2009)) and trade policy uncertainty specifically (e.g. Pierce and Schott (2016); Crowley et al. (2018a); and Handley and Limão (2017)).<sup>7</sup> While these papers have documented the effects of trade policy uncertainty on trade, investment, and firm entry/exit, we demonstrate that this uncertainty can also feed through to affect labour markets, as reflected in online job postings. We also add to the growing literature documenting the economic consequences of the uncertainty sur-

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<sup>7</sup>For a review of the theoretical literature on economic policy uncertainty, see Dixit and Pindyck (1994). For a review of some of the empirical literature, see Baker et al. (2016).

rounding Brexit specifically, which includes studies by [Crowley et al. \(2018b\)](#), [Graziano et al. \(2018\)](#), [Costa et al. \(2019\)](#), [Bloom et al. \(2019\)](#) and [Breinlich et al. \(2019\)](#). We add to this body of work by shedding new light on the important role of services trade barriers specifically and consequences of the referendum for labour markets as captured by online job adverts.

Finally, we add to a relatively new literature using real-time labour market data, such as online job adverts, to study labour markets ([Hershbein and Kahn, 2018](#); [Deming and Noray, 2018](#); [Deming and Kahn, 2017](#)), shedding light on the substantial decline in the posting of online job adverts in the UK after 2017.

This paper proceeds as follows: Section 2 provides background information on the referendum, Section 3 outlines the empirical strategy, Section 4 summarises the data sources used and construction of our exposure measures, Section 5 presents the baseline results, Section 6 presents additional results and mechanisms, Section 7 presents robustness checks and Section 8 concludes.

## **2. Background on the Brexit Referendum**

The UK electorate chose to leave the EU on the 23rd June 2016 with 51.9 percent voting in favour of leaving the EU and 48.1 percent voting in favour of remaining in the EU. The unexpected nature of this vote was evidenced by the betting markets that had placed the likelihood of a ‘leave’ outcome at around 30 percent for most of the preceding year, and the fact that the pound-dollar exchange rate fell by 8 percent in the 24 hours following the referendum, sterling’s biggest one-day loss since the introduction of free-floating exchange rates in the 1970s.

The referendum was the start of an extended period of profound uncertainty about the future UK-EU relationship. [Table 7](#) in the Online Appendix provides a summary of the key events and dates relating to the referendum and the negotiation period. The post-referendum timeline can be split into three key parts: the negotiation period following the vote in June 2016 but prior to the UK leaving the EU on the 31st January 2020; the transition period after leaving the EU; and the final deal. Our analysis covers the first period, with our data spanning from January 2015 to December 2019. The primary objective during this period was to negotiate a legally binding ‘withdrawal agreement’ covering the terms of the transition period, and a non-legally binding ‘political declaration’ regarding aims for the fi-

nal deal.

The negotiation period consisted of significant ups and downs including three general elections, two changes of Prime Minister and multiple failed votes in parliament. For each of the key policy areas affected by Brexit, there was substantial uncertainty during the negotiation period about which of many potential outcomes would be realised. Consensus is now building that this led to *delayed economic responses* to the referendum, as firms and individuals waited for more clarity on specific issues and policies.

Two events brought some clarity during this tumultuous period. The first one was the invocation of Article 50 on the 29th March 2017, which was legally required for the UK to start a formal withdrawal process from the EU. The second one was the publication of UK Government's White Paper on 'The Future Relationship between the United Kingdom and the European Union' on the 12th July 2018, which clarified the Government's negotiating stance stating that controlling migration was a key priority, while recognizing that it would come at the expense of severely diminished market access for UK services exporters. The White Paper was described as 'a real blow for the UK's financial and related professional services sector', by the City of London Corporation.<sup>8</sup>

In general, the possibility of trade barriers for both goods and services became increasingly likely as the negotiation period progressed. For goods trade increased tariffs were a possibility primarily under a no deal scenario, meaning that the risk became sizable only later on. For services trade there was a sizeable risk of substantial barriers even under the trade deal scenario.

## **2.1 Negotiation period scenarios for trade policy**

During the negotiation period, UK firms trading with the EU faced a spectrum of scenarios for potential future trade arrangements upon leaving the EU, with three primary possibilities, each with different associated regulatory barriers and tariff schedules: (i) staying in the Single Market; (ii) leaving the Single Market and negotiating a comprehensive free trade deal, and (iii) leaving with no deal.

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<sup>8</sup>By 2018 many financial institutions had already started to move their corporate headquarters, branches and staff away from the UK. [New Financial \(2019\)](#) reported in March 2019 that 275 financial institutions had moved or were moving at least part of their operations to elsewhere in the EU.

### **2.1.1 Scenario 1: Staying in the Single Market**

The ‘Single Market’ outcome would have ensured continued frictionless and barrier-free trade in goods and services. This scenario had the perceived political drawbacks of the UK not being able to freely negotiate its own trade agreements and not having a say in future EU negotiations. In addition, remaining in the Single Market would have involved maintaining the ‘four pillars’ of free movement of goods, services, capital and people within the Single Market, implying that the UK would have been unable to limit immigration from the EU, which was a contentious political issue.

### **2.1.2 Scenario 2: A Free Trade Agreement**

Another scenario was one in which the UK would maintain some degree of preferential trade arrangements with the EU, while retaining control over immigration and regulation. It was typically discussed that this scenario would involve limited regulatory alignment with the EU and hence would imply some barriers on services trade, but the majority of goods would be traded without being subject to tariffs.<sup>9</sup>

### **2.1.3 Scenario 3: A ‘No Deal’ Brexit**

The final possible outcome was a ‘no deal’, where the UK’s services exports would revert to being governed only by the terms set under the GATS, and exports of goods would be subject to the EU’s WTO tariff schedule. Although widely considered as a very negative outcome for businesses, the option was first promoted by Theresa May when she argued that ‘no deal is better than a bad deal’ and later supported by Boris Johnson who replaced her as Prime Minister.

### **2.1.4 Implications of various scenarios for financial services exports to the EU**

The EU Single Market is the most integrated area in terms of services trade in the world. Under the Single Market rules, any financial businesses authorised in any Member State can operate freely across the EEA, through a system known as ‘passporting’. Leaving the Single

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<sup>9</sup>A key challenge for this scenario was ensuring that there wouldn’t be a hard border between Northern Ireland and the Republic of Ireland, as a hard border was perceived as a major threat to the Good Friday Agreement designed to maintain peace in the region.

Market thus meant that UK financial services firms would lose their EU passports.

Under a preferential trade agreement, the UK and the EU could have in principle agreed on ‘mutual recognition’ of each other’s financial services regulatory regimes. However, the concept of mutual recognition was not consistent with the EU’s negotiating position on the four freedoms of the Single Market being indivisible and so this option was not discussed for very long. The UK Government’s White Paper, published on the 12th July 2018, moved away from mutual recognition as the preferred option for the financial service sector, focusing instead on ‘equivalence’. Equivalence would allow UK and EU financial businesses to carry out specified activities across borders as long as the regulations that underpin these activities were deemed to achieve comparable outcomes. However, an equivalence regime is difficult to negotiate, can be revoked at any time and is far less all-encompassing than passporting rights. Moreover, there was a tension between the objective of equivalence and the UK’s desire to chart its own regulatory path.<sup>10</sup>

Under a no-deal scenario, the UK would have become a ‘third country’ in the eyes of EU member states. UK financial services firms would be treated in the same way as other WTO members with the trade in financial services being guided by the GATS commitments made by each individual EU member state, implying significant barriers to exports by UK based providers. Note that from the perspective of the UK, the GATS commitments of the EEA members can be considered exogenous, as the vast majority of these commitments entered into force on 1 January 1995.

### 3. Empirical strategy

Our baseline specification examines the impact of a labour market’s exposure to potential trade barriers on monthly online job postings in the pre- versus the post-referendum period:

$$\log(\text{postings}_{rt}) = \beta_0 + \beta_1 \text{trade barrier threat}_r \times \text{post vote}_t + \beta_2 X_r \times \text{post vote}_t + \gamma_t + \gamma_r + \epsilon_{rt} \quad (1)$$

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<sup>10</sup>Although at the time of writing this paper more than a year has passed from the end of the transition period, the EU has not granted equivalence status to the UK financial sector. This resulted in a ban on EU-based financial institutions trading in UK exchanges and trading venues and prompted the move of some security trading to other locations, including Amsterdam. See <https://www.ft.com/content/3dad4ef3-59e8-437e-8f63-f629a5b7d0aa>.

where  $\text{postings}_{rt}$  are the total number of online job adverts posted in month-year  $t$  and TTWA  $r$ ,  $\text{post vote}_t$  is a dummy variable for the time period after the referendum,  $\text{trade barrier threat}_r$  is a measure of the exposure of TTWA  $r$  to future trade barriers between the UK and the EU, and  $X_r$  includes exchange rate and immigration controls.

We do not include the post-vote variable on its own, as our specification includes month-year dummy variables. We include TTWA fixed effects to control for TTWA-specific, time-invariant factors. The sample covers the period of January 2015 to December 2019.

We will also estimate this specification for different skill and occupational groups, as defined in Section 4.5.

## 4. Data and variable definitions

### 4.1 Online job adverts

We use data collected by Burning Glass Technologies (BGT), a company that scrapes, parses and deduplicates online job postings on a daily basis and creates labour market analytics products using this data.<sup>11</sup> BGT's postings are sourced from approximately 40,000 online job boards and company websites, resulting in a sample containing nearly all job adverts posted online. There are around 60 million UK job adverts in their data over the period 2012-2019. In Online Appendix D, we provide a detailed discussion of BGT's data coverage relative to other sources of labour market data for the UK. We show that between 2012 and 2019 the number of job adverts included in BGT's data is approximately 86 percent of the total number of vacancies in the UK economy, as reported by the ONS UK Vacancy Survey.

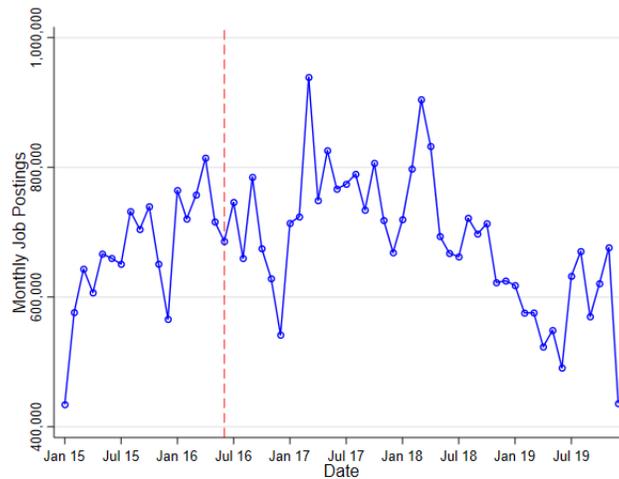
The BGT data has the advantage of being very rich in detail: BGT classify the job adverts along a range of dimensions, most important for us are the detailed classification by TTWA and SOC (Standard Occupational Classification) codes. However, online job adverts data inevitably only cover the subset of all vacancies advertised online.<sup>12</sup> The postings cover 228

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<sup>11</sup>Duplicates are recorded as a single posting in the first period in which the posting occurs.

<sup>12</sup>Hershbein and Kahn (2018) provide a detailed analysis of the industry-occupation mix of vacancies in BGT relative to other detailed US data sources, such as JOLTS, and how this mix has changed over time. They find that the BGT postings are disproportionately concentrated in occupations and industries that typically require greater skill, but that the distributions are relatively stable across time and the aggregate and industry trends in the quantity of vacancies track official sources reasonably closely. Therefore, while online job adverts do not provide a complete picture of the entire labour market, they can provide a useful barometer of labour market demand.

Figure 1: Monthly online job postings in the UK



Notes: Raw unsmoothed total monthly postings data. The vertical red dotted line identifies the month of the Brexit referendum.

TTWAs across the UK, with 76 percent of total job postings being classified with a TTWA. The final dataset includes 213 TTWAs, due first to the exclusion of the 10 TTWAs in Northern Ireland from the BRES employment data, discussed below, and second to the exclusion of 5 small TTWAs which are not present in the BGT data. This leaves us with a final dataset with 213 TTWAs for 60 months, resulting in 12,780 observations. Table 8 in the Online Appendix displays summary statistics for monthly job postings and all other key variables used in the paper.

Over the period considered in our analysis, January 2015 to December 2019, a total of 31,208,288 postings are present in our dataset, translating into an average of 6,241,658 per year. Figure 1 displays the time series of UK monthly job postings over the period of our analysis. They follow an upwards trend prior to the referendum before flattening out and starting to decrease from mid-2018. We are interested in understanding to what extent concerns about a future relationship with the EU played into this decrease.

## 4.2 Employment composition in local labour markets

Our analysis uses UK TTWAs as our statistical unit. TTWAs aim to reflect the geographic region where the population would generally commute to a larger town, city or conurbation for the purposes of employment. The current criteria for defining TTWAs are that at least 75 percent of the area's resident workforce work in the area, at least 75 percent of the people

who work in the area also live in the area, and the area must have an economically active population of at least 3,500. TTWAs range in population size from 6,800 to 8.4 million.<sup>13</sup>

To capture industry composition of employment in each TTWA we use employment data from the UK Business Register and Employment Survey (BRES). The UK's Office for National Statistics (ONS) describes BRES as the UK's *official source of employee and employment estimates by detailed geography and industry*, and it is the most widely used dataset for UK local labour market analysis (see, for example, [Manning and Petrongolo \(2017\)](#)). BRES contains a breakdown of employment by SIC4 industry within each TTWA in the UK.<sup>14</sup> BRES collects employment information from businesses across the whole of the Great Britain economy for each site that they operate.<sup>15</sup> BRES surveys approximately 85,000 businesses. In 2015, the BRES data capture 28.5 million employees, or 91 percent of the total UK labour force as estimated by the ONS.<sup>16</sup>

We take into account all employed individuals, where an employee is defined as anyone aged 16 years or over that is paid directly from the payroll, in return for carrying out a full-time or part-time job or being on a training scheme. Employment includes employees plus the number of working owners who receive drawings or a share of the profits. We focus on employment figures for 2015, the year before the Brexit referendum. Although 2014 figures might have been slightly more preferable, our decision was motivated by the substantial improvement in the BRES sampling which took place in 2015.<sup>17</sup>

### 4.3 TTWA exposure to barriers on exports of professional services

Our aim is to quantify the threat of future barriers on UK exports of services to the EU. We consider a scenario of the UK leaving the EU without an explicit agreement on services. Under this scenario, the UK is no longer part of the EU's Single Market, becomes a 'third country'

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<sup>13</sup>TTWAs are defined by the ONS using census data for commuting between wards, based on the different locations of individuals' home and work addresses. See <https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/articles/traveltoworkareanalysinggreatbritain/2016>

<sup>14</sup>Agricultural employment (i.e., SIC codes 0111-0150) is excluded from the BRES.

<sup>15</sup>The same information is collected separately for Northern Ireland.

<sup>16</sup><https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/bulletins/uklabourmarket/2015-07-15>. As BRES is a business survey, the quality of the industry classifications is preferable to industry data from household surveys such as the Annual Population Survey, which we use for the immigration controls.

<sup>17</sup>Prior to that year, BRES excluded business units with a single Pay As You Earn code, for which no Value Added Tax data were available.

to the EU for the purpose of services trade, and trade with the bloc follows the WTO's GATS rules set by individual EU Member States.

We capture export barriers associated with this scenario using the OECD STRI. The STRI contains indices that measure MFN service trade restrictions in each destination country and sector. It does not take into account any specific concessions or preferential trade agreements. For each country and sector, five policy areas are considered: restrictions on foreign entry, restrictions on the movement of people, barriers to competition, regulatory transparency, and other discriminatory measures. The policy measures are grouped under these five policy areas in all sectors, and turned into an index using a scoring and weighing technique designed by the OECD. The indices take values from 0 to 1, with 1 indicating a market completely closed to foreign services providers and 0 meaning a fully liberalised sector. Examples of regulations included in the STRI are included in Appendix C.<sup>18</sup>

To capture the pre-Brexit restrictions on services exports we use the OECD Intra-EEA STRI. The intra-EEA STRI identifies and catalogues trade policy restrictions within the EEA for 24 member countries, which are OECD members. The information in the intra-EEA STRI covers EU law as well as national legislation. The values of STRI and Intra-EEA STRI differ across EEA member countries, reflecting differences in national legislation.<sup>19</sup>

To capture the threat of barriers arising from the Brexit scenario outlined above relative to the pre-Brexit situation, we combine the two indices for the overlapping subset of 24 countries and calculate the 'gap' between services trade restrictions placed on MFN partners versus countries within the EEA.<sup>20</sup> The UK is not included in the Intra-EEA STRI and hence we are not able to construct an equivalent measure for import competition. We use the STRI values for 2014 to capture restrictions that were in place prior to Brexit discussions. Of the 22 sectors, we exclude those relating to transport, logistics, construction and the arts (Broadcasting, motion pictures and sound recording) such that we are left with an index that captures primarily professional service exports. The sectors we include are: Accounting, Architecture, Commercial Banking, Computer services, Engineering, Insurance, Legal and Tele-

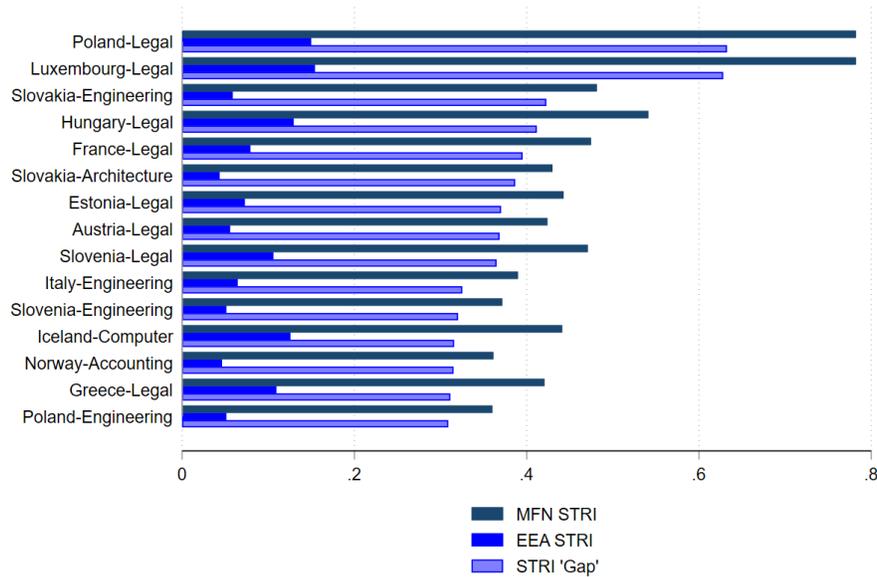
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<sup>18</sup>The STRI was assembled by analysing laws and regulations in 34 OECD countries as well as Brazil, China, India, Indonesia, Russia, and South Africa. For more information, see <https://qdd.oecd.org/subject.aspx?Subject=063bee63-475f-427c-8b50-c19bffa7392d>.

<sup>19</sup>[https://www.oecd-ilibrary.org/trade/intra-eea-stri-database\\_2aac6d21-en](https://www.oecd-ilibrary.org/trade/intra-eea-stri-database_2aac6d21-en).

<sup>20</sup>The 24 included countries are: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden. Excluded countries include: Bulgaria, Croatia, Republic of Cyprus, Liechtenstein, Malta, Romania.

Figure 2: Country-sector pairs with highest STRI ‘gap’



Notes: The figure presents the OECD’s STRI (‘MFN STRI’) and Intra-EEA STRI (‘EEA STRI’) and the difference between them (‘STRI gap’) for the country-sector pairs with the highest gap. The STRIs range from 0 to 1, with 1 representing the most restrictive. Sources: OECD STRI.

coms.<sup>21</sup>

Figure 2 displays the top 15 country-sector pairs ranked by the difference between the MFN and intra-EEA STRIs. Legal services are the most commonly featured service type in this ranking, with the highest ranked differences being ‘Legal services’ in Poland, Luxembourg and ‘Engineering services’ in Slovakia. For the trade-weighted STRI gap, the Legal sector also ranks highest, followed by Architecture, Accounting, Computer Services, Information Services, Engineering, Financial Services, Insurance, then Telecoms with the lowest STRI gap.

For each services sector  $j^{serv}$  considered, we calculate the STRI ‘gap’. It is an average of the expected increase in the level of destination country specific restrictions, weighted by UK exports of services industry  $j^{serv}$  to a given EEA country in 2015. The export figures come from the ONS.<sup>22</sup>

To capture tradability of each sector  $j^{serv}$ , we multiply the weighted average by the value of total exports of sector  $j^{serv}$  to the EEA per person employed in this sector in the UK. Thus

<sup>21</sup>We focus primarily on professional services due to both the feasibility of mapping between UK industries and STRI sectors, as well as the ease of interpreting the effect of trade restrictions on GATS Mode 1 services trade which comprises of services that are supplied across borders.

<sup>22</sup>We use the 2015 trade data because exports of services by detailed service type and country was not available prior to 2015. We map the ONS service types to the STRI sectors using the mapping described in Table 9 of Online Appendix B.

the sector specific threat of export barriers is defined as follows:

$$\text{services barrier exposure}_{j^{serv}} = \frac{\text{Exports}_{j^{serv},2015}}{L_{j^{serv},2015}} \times \text{avg STRI gap}_{j^{serv},2014} \quad (2)$$

where the avg STRI gap $_{j^{serv},2014}$  is the trade weighted average difference between the 2014 MFN STRI and intra-EEA STRI for industry  $j^{serv}$  across EEA countries, where the weights are EEA country shares in UK exports to the EEA in sector  $j^{serv}$ . Exports $_{j^{serv},2015}$  are total exports to the EEA in sector  $j^{serv}$  in 2015.<sup>23</sup>

We then construct measures of the services barrier exposure at the local labour market level. This exposure is defined as the average value of exposure across all services industries, weighted by each industry's share in the TTWA's employment:

$$\text{services barrier exposure}_r = \sum_{j^{serv} \in r} \text{empl share}_{j^{serv}r,2015} \times \text{services barriers exposure}_{j^{serv}} \quad (3)$$

where empl share $_{servr,2015}$  is employment in sector  $j^{serv}$  and TTWA  $r$  as a fraction of total employment in TTWA  $r$  in 2015.

Figure 3 presents a map of this measure by TTWA, with darker blue representing a greater exposure to services barriers. There is an unsurprising concentration around the South East and London, combined with a number of very exposed areas in the North of England and Scotland. Figure 8 in the Online Appendix displays the 15 most exposed TTWAs: London ranks only 5th overall, with Edinburgh, Halifax, Trowbridge, Swindon and Skipton ranked as more exposed.

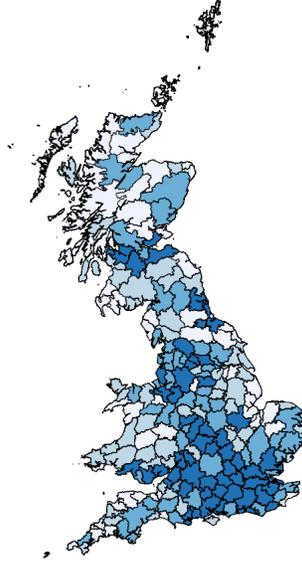
#### 4.4 TTWA exposure to tariffs

This section explains the construction of the TTWA exposure to barriers on goods exports. Under the scenario considered, trade between the UK and the EU would be subject to the WTO rules and the EU would apply MFN tariffs to goods imported from the UK.

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<sup>23</sup>Expressing exports in per worker terms follows the approach of Autor et al. (2013) and Blanchard et al. (2019). It allows us to capture tradability, i.e. the importance of exports for the given sector, as well as employment dependence on exports within the sector which maps directly to the decision of whether or not a firm decides to increase hiring and hence to post a job advert.

Figure 3: Exposure by Travel to Work Area: Services barrier exposure



Notes: This map displays the baseline employment-weighted services barrier exposure for each TTWA. Darker colours represent more exposed areas.

We use tariff data from the World Integrated Trade Solution (WITS) database, selecting the applied MFN tariffs that the EU levies on imports coming from the rest of the world (excluding countries with which the EU has preferential trading arrangements). The data are aggregated at the 6-digit level of the Harmonised System (HS6) and represent the simple average of tariffs across higher levels of disaggregation. We match these tariffs to UK exports to the EU-27 at the HS6 level. Then, in order to calculate the average MFN tariff per sector, we match the combined dataset with 4-digit ISIC codes using crosswalks provided by the UN Statistics Division.<sup>24</sup> As was the case with services exposure, we multiply the average weighted MFN tariff by the value of UK exports to the EU per employee in the sector.<sup>25</sup>

More specifically, our industry-level measure of tariff exposure is defined as follows:

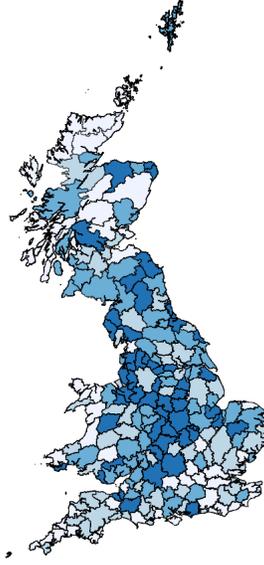
$$\text{tariff exposure}_{j^{manu},2014} = \frac{\text{Exports}_{j^{manu},2014}}{L_{j^{manu},2015}} \times \text{avg MFN tariff}_{j^{manu},2014} \quad (4)$$

where  $\text{avg MFN tariff}_{j^{manu},2014}$  is the UK export-weighted average EU MFN ad valorem tariff across all HS6 products mapped to manufacturing sector  $j^{manu}$ ,  $\text{Exports}_{j^{manu},2014}$  are exports

<sup>24</sup>[unstats.un.org/unsd/classifications/econ/](http://unstats.un.org/unsd/classifications/econ/). We use CPC Ver 2.1 as an intermediate nomenclature between HS 2012 and ISIC Rev. 4.

<sup>25</sup>The employment data is provided at the UK SIC 2007 level (equivalent to NACE Rev. 2 up to the 4-digit level) but can be straightforwardly aggregated to the ISIC Rev. 4 level using a concordance from the same UN stats source.

Figure 4: Exposure by Travel to Work Area: tariff barriers



Notes: This map displays the baseline employment-weighted tariff exposure for each TTWA. Darker colours represent more exposed areas.

from the UK's sector  $j^{manu}$  to the EU-27 in 2014, and  $L_{j^{manu},2015}$  is the total national employment in sector  $j^{manu}$  in 2015. This measure is calculated for 147 SIC4 manufacturing industries, i.e. those in SIC Division C. We use the 2014 tariffs for two reasons. First, we want to avoid the unlikely possibility that the EU might be strategically adjusting its MFN tariffs in anticipation of the possibility of Brexit. Second, our analysis uses a trade-weighted tariff measure and we want to avoid the possibility of trade flows being affected by the referendum results.

We then construct a measure of the local labour market exposure to tariffs:

$$\text{tariff exposure}_r = \sum_{j^{manu} \in r} \text{empl share}_{j^{manu},r,2015} \times \text{tariff exposure}_{j^{manu}} \quad (5)$$

where  $\text{empl share}_{j^{manu},r,2015}$  is employment in sector  $j^{manu}$  and TTWA  $r$  as a fraction of total employment in TTWA  $r$ .

Figure 4 provides a map of the exposure measures, and Figure 11 in the Online Appendix displays the top 15 TTWAs by exposure level. The most exposed TTWAs include Hawick & Kelso, Whitehaven, and Fraserburgh, all in the North of England or Scotland. In contrast with the services barrier exposure, the map shows a concentration in the Midlands with relatively little exposure in the South East and London.

We focus primarily on the effect of future MFN tariffs on UK exports, rather than UK im-

port tariffs, for a few reasons. First, while the UK would not be able to control the tariffs placed upon its exports if it left the EU without a trade deal, it would be able to directly control its import tariffs. In addition, it was often suggested during the negotiation period that the UK would unilaterally place low, or zero, tariffs on imports if it were to leave without a deal.<sup>26</sup> We would therefore expect that the perceived risk of harm from future import tariffs would be substantially lower than the risk of harm from tariffs on UK exports, which were widely known to default to WTO terms if the UK left without a deal. This said, measures that take into account potential import tariffs are included in our robustness checks.

#### **4.5 Classifying job adverts by occupation and skill**

The job postings data provide information on the occupational classification of each of the postings at the 4 digit SOC level. Examples include ‘Managers and proprietors in agriculture and horticulture’ or ‘Metal plate workers, and riveters’. These can be aggregated to nine 1-digit groups as presented in Table 10 in the Online Appendix. The ONS classifies the 2-digit sub-major groups of the SOC 2010 into four skill levels where ‘skill level is defined with respect to the duration of training and/or work experience recognised in the field of employment concerned as being normally required in order to perform the activities related to a job in a competent and efficient manner’.<sup>27</sup>

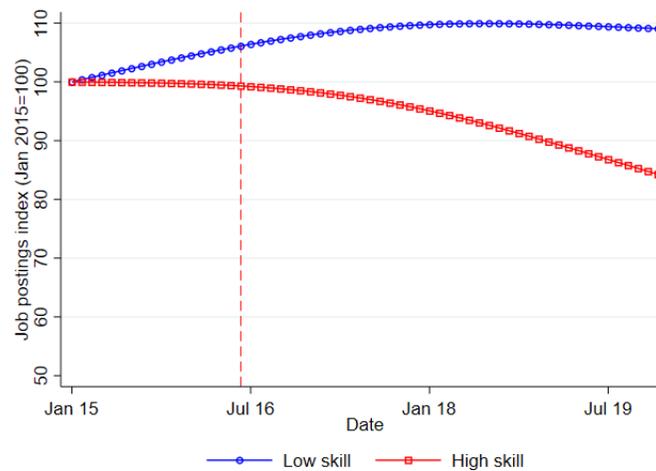
We define the top two levels (3 and 4) as ‘high skill’ and the bottom two (1 and 2) as ‘low skill’. Examples of high skill sub-major groups include ‘Science, research, engineering and technology professionals’ (level 4) and ‘Business and public service associate professionals’ (level 3). Examples of low skill sub-major groups include ‘Administrative occupations’ and ‘Elementary trades, plant and storage related occupations’. Figure 5 displays the evolution of high skill and low skill job postings over time, we see a clear gap between the progression of the two types with high skill postings overall decreasing, and low skill postings marginally increasing over the period.

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<sup>26</sup>For example, see <https://www.ft.com/content/d97854c2-2941-11e9-a5ab-ff8ef2b976c7>

<sup>27</sup><https://www.ons.gov.uk/methodology/classificationsandstandards/standardoccupationalclassificationsoc/soc2010/soc2010volume1structureanddescriptionsofunitgroups>

Figure 5: High skilled and low skilled job postings over time



Notes: Both trend lines are smoothed using the Hodrick-Prescott time-series filter, removing cyclical components, and normalised to 100 in January 2015 for comparison. The vertical red dotted line identifies the date of the Brexit referendum.

## 4.6 Control variables

During the period considered, job adverts may have also been affected by other factors arising from the result of the Brexit referendum. These include: expected changes to the immigration rules applying to EU nationals and the sharp depreciation of the pound sterling after the referendum.

### 4.6.1 Accounting for expected changes to immigration policy

Immigration was a central theme of the Brexit campaign and was one of the policy areas given priority during the negotiation period. The referendum result introduced the prospect of ending free movement of people between the UK and EU, which would limit the future ability of UK firms to employ EU nationals. We, therefore, introduce an additional control for a TTWA's share of employment of EU nationals and Eastern European (defined as EU8) nationals in the pre-referendum period, interacted with the post-referendum dummy.<sup>28</sup>

To measure the employment share of EU and EU8 nationals in a TTWA before the vote we use data from the Annual Population Survey (APS) in 2015. The APS is a continuous household survey covering the UK, with the aim of providing between-census estimates of key so-

<sup>28</sup>The EU8 countries are a group of eight of the 10 countries that joined the European Union during its 2004 enlargement. They are commonly grouped together separately from the other two states that joined in 2004, Cyprus and Malta, because of their relatively lower per capita income levels in comparison to the EU average. They are the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia.

cial and labour market variables at a local area level. The APS is not a stand-alone survey, but combines data from two waves of the main Labour Force Survey (LFS) with data collected on a local sample boost. The datasets comprise 12 months of survey data and are disseminated quarterly, with an achieved sample size of approximately 320,000 respondents. The APS is the most comprehensive source of data on employment by nationality of workers and is typically used for research on immigration in the UK.

The data provide a breakdown of the share of employment of EU and EU8 nationals in each UK NUTS1 region and SIC1 industry. We use data on the SIC1 employment composition of each TTWA in a given region to construct the employment share measures. The measure is defined as:

$$\text{EU national share}_{r,NUTS1} = \sum_{k \in r} \text{empl sh}_{kr,2015} \times \frac{\text{EU workers}_{k,NUTS1}}{L_{k,NUTS1}} \quad (6)$$

where  $r$  is the TTWA,  $NUTS1$  is the NUTS1 region in which the TTWA is located, and  $k$  the SIC1 sector. Total workers,  $L_{k,NUTS1}$ , include any individual in employment, and EU workers include any EU national in UK employment. We construct an analogous measure for nationals of the EU8 member states. A map of these measures is displayed in Figure 12 of Online Appendix A.

It is not clear what sign we should expect this control variable to bear. On the one hand, firms may be interested in hiring EU workers prior to the post-Brexit migration controls being introduced. On the other hand, firm may be postponing expansion being concerned about difficulties with hiring migrant workers in the future.

#### 4.6.2 Accounting for exchange rate changes

One of the most notable immediate impacts of the EU referendum was the large overnight depreciation of the pound with respect to the dollar and euro, the magnitude of which speaks to the unexpected nature of the referendum results. The exchange rate was somewhat volatile in the year and a half prior to the referendum, but the pound remained weaker throughout the negotiation period relative to the pre-referendum period. UK firms are likely to have been affected by these fluctuations, both through increased cost of imported inputs and through increased competitiveness of export products.

In order to control for this variation, we construct a straightforward exchange rate control

which multiplies the real effective exchange rate (REER) by a weighted sum of sectoral exports per worker multiplied by sectoral employment in each TTWA:<sup>29</sup>

$$E_{rt}^X \equiv \sum_j \text{empl sh}_{jr,2015} \times \frac{\text{Exports}_{j,2014}}{L_{j,2015}} \times REER_t$$

This creates a TTWA-specific exchange rate measure which varies at a monthly frequency. We also construct an imported-input based exchange rate exposure measure which replaces  $\text{Exports}_{j,2014}$  by the equivalent sectoral sum of imported inputs. The latter measure is used in robustness checks.

## 5. Estimation Results

### 5.1 Baseline results

We start with our baseline specification laid out in equation 1 gradually adding controls. The results are presented in Table 1. Column (1) shows the coefficient on the interaction term between the post vote dummy variable and the TTWA trade-weighted services barrier exposure measure, and column (2) additionally includes the tariff exposure measure. Columns (3)-(5) subsequently add the controls described earlier in the paper. Across all columns, the estimated coefficient on the interaction with the services barrier exposure is negative and significant at the 1 percent level with the magnitude varying between -0.538 and -0.559. Taking column (4) as our preferred specification, a one standard deviation increase in services barrier exposure (0.09) leads to a 4.95 percent decrease in monthly postings.

The estimated coefficient on the interaction with the tariff measure is close to zero and insignificant across all specifications. Other control variables also fail to reach statistical significance.

### 5.2 Professional services barrier exposure: Event study

We also conduct an event study allowing the effects of exposure to barriers on professional services exports to differ by quarter. Quarters 1 & 2 from 2015 are excluded so all coefficients are relative to these quarters. As before, we control for the EU immigrant share and tariff

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<sup>29</sup>The data on the real effective exchange rate come from the IMF. The REER is defined as the value of a currency against a weighted average of several foreign currencies divided by a price deflator or index of costs.

Table 1: Baseline post-vote results

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * service barrier exposure	-0.538*** (0.132)	-0.540*** (0.132)	-0.559*** (0.134)	-0.553*** (0.127)	-0.557*** (0.133)
post vote * tariff exposure		-0.008 (0.033)	-0.029 (0.055)	-0.029 (0.055)	-0.029 (0.054)
export REER			-0.135 (0.146)	-0.136 (0.146)	-0.141 (0.146)
post vote * EU national share				-0.267 (0.861)	
post vote * EU8 national share					-0.885 (1.377)
Observations	12,780	12,780	12,780	12,780	12,780
Adjusted R-squared	0.984	0.984	0.984	0.984	0.984
TTWA FE	YES	YES	YES	YES	YES
Month-Year FE	YES	YES	YES	YES	YES

Notes: This table displays the results from the regressions of the log of monthly job postings in each TTWA on the average trade barrier exposure measures at the TTWA level interacted with the post vote dummy variable, with and without controls. All specifications include TTWA and month-year fixed effects, and standard errors (in parentheses) are two-way clustered at the TTWA and month-year level. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

exposure interacted with the post-vote dummy and and export exchange rate control, and for month-year and TTWA fixed effects.

Three observations emerge from the estimates depicted in Figure 6. First, the pre-referendum coefficient estimates are very close to zero and not statistically significant, which is consistent with the absence of divergent pre-trends that would have clouded our analysis. Second, for three quarters after the referendum, the coefficients remain very close to zero and fail to reach statistical significance. This is consistent with the view that the surprising outcome of the referendum meant that there was no unified vision in the Conservative Party of what the post-Brexit future would look like.<sup>30</sup> However, any doubts that may have existed with regard to the Government's commitment to implement the referendum outcome were dispelled on the 29th March 2017 with the invocation of Article 50 by Theresa May. This coincides with a downshift in magnitude of the estimated coefficients starting in Q2 2017, with the first statistically significant and negative coefficient being observed in this quarter. All coefficients from this point on are negative and statistically significant.

Third, although the invocation of Article 50 clearly stated the UK's intention to leave the EU, it took a long time for the government to articulate its vision for the post-Brexit future. This eventually happened on the 12th July 2018 when the UK Government publishes its

<sup>30</sup>This lack of unified vision within the Conservative Party eventually led to Theresa May's resignation from the prime ministerial post.

White Paper. The paper confirmed that "Britain would seek a "free trade area" for goods (...). But it also set out plans for a looser relationship on services, which represent 80 percent of the British economy, including financial services."<sup>31</sup> At that point, it became very clear that the Government was willing to accept barriers to UK services exports in order to be able to control migration of EU citizens to the UK. As visible in the graph, there was a clear downward jump in the job posting in the quarter following the publication of the White Paper (Q3 2018) with some decline already visible in Q2 2018.

In sum, the delayed effect observed in the data is consistent with the explanation that there was an initial period post-referendum where firms were trying to understand the future consequences of the vote. These results imply that firms only responded by adjusting the posting of vacancies once it became clear that the likely outcome of negotiations was a significant separation from the Single Market.

An equivalent event study for the immigration exposure measures, displayed in Figure 13 in the Online Appendix, shows that the quarterly interactions were insignificant until Q3 2018 and were subsequently all negative and significant, consistent with the explanation that labour markets in areas employing more EU and EU8 nationals only responded with a delay after it became clear that the UK would make a significant break from the Single Market.<sup>32</sup>

### 5.3 Impact on different skill groups

The UK has a comparative advantage in exports of skill-intensive services, so we would expect postings for high skilled jobs to be affected more than low skilled postings. We test this by estimating our baseline specification separately for high skilled and low skilled job adverts.<sup>33</sup> The estimation results are presented in Table 2, where panel (a) displays the results for high skilled job adverts, while panel (b) shows the results for low skilled job adverts.

The estimates are consistent with our expectations. Although, the coefficients on the variable of interest are negative and statistically significant in all specifications, their magnitudes are twice as large for high skilled as for low skilled job postings. Taking column (4) for the high skilled postings, we see that a one standard deviation increase in exposure leads to a

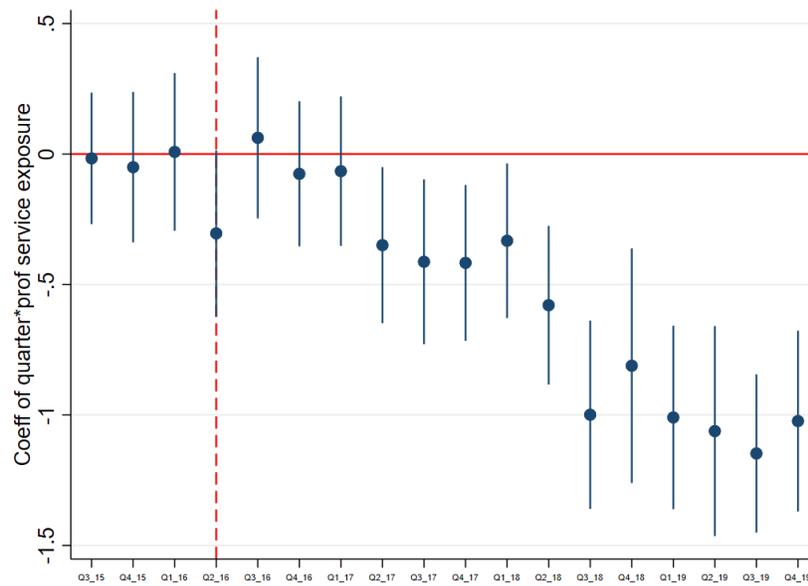
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<sup>31</sup><https://www.ft.com/content/702ac352-85bc-11e8-96dd-fa565ec55929>

<sup>32</sup>An equivalent event study for tariff exposure yielded no quarter with statistically significant coefficients and so is not displayed.

<sup>33</sup>Skill classification of jobs is described in Section 4.5.

Figure 6: Impact of professional services exposure over time



*Notes:* This graph shows the coefficients from the regression of the log of monthly job postings on the professional services barrier exposure measure at the TTWA level interacted with a dummy variable for each quarter from Q3 2015 to Q4 2019, controlling for the EU immigrant share interacted with the post vote dummy variable, tariff exposure interacted with the post vote dummy variable, exposure to the export REER, TTWA fixed effects and month-year fixed effects. Coefficients are relative to the base period of Q1 2015 and Q2 2015. The dots represent the point estimates and the lines the 90 percent confidence intervals. The red line shows the quarter when the referendum occurred, Q2 2016.

5.76 percent decrease in postings, compared to 2.64 percent decrease for low skilled postings and 4.95 percent for the aggregate postings found previously.

The expected barriers to services exports are likely to have unequal effects across occupations. To understand which occupations were affected most, next we estimate our baseline specification for each of the nine occupational (SOC) groups separately.<sup>34</sup> The estimation results are summarized in Table 3 below. We find the strongest negative and statistically significant effects of exposure to barriers on professional services exports for three out of the nine occupations. These are: Managers, Directors and Senior Officials; Professional Occupations; and Associate Professional and Technical Occupations. The coefficients range from -0.819 for Professional Occupations to -0.530 for Associate Professional and Technical Occupations, which corresponds to a -7.3% and -4.8% decline, respectively, for a one standard deviation change in exposure to services barriers.

Another interesting finding is the negative and statistically significant effect of exposure to tariffs on goods on the job postings for Process, Plant and Machine Operatives. This occupa-

<sup>34</sup>The classification of occupations is described in Table 10 of Section 4.5.

Table 2: Impact by skill group

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
Panel (a) High skill					
post vote * service barrier exposure	-0.637*** (0.132)	-0.635*** (0.132)	-0.649*** (0.133)	-0.642*** (0.127)	-0.647*** (0.132)
post vote * tariff exposure		0.009 (0.032)	-0.006 (0.050)	-0.006 (0.050)	-0.006 (0.050)
export REER			-0.097 (0.134)	-0.098 (0.134)	-0.105 (0.133)
post vote * EU national share				-0.280 (0.861)	
post vote * EU8 national share					-1.119 (1.382)
Observations	12,773	12,773	12,773	12,773	12,773
Adjusted R-squared	0.982	0.982	0.982	0.982	0.982
Panel (b) Low skill					
post vote * service barrier exposure	-0.280** (0.127)	-0.283** (0.127)	-0.297** (0.128)	-0.298** (0.122)	-0.296** (0.127)
post vote * tariff exposure		-0.017 (0.037)	-0.032 (0.056)	-0.032 (0.056)	-0.032 (0.056)
export REER			-0.094 (0.140)	-0.094 (0.140)	-0.096 (0.140)
post vote * EU national share				0.079 (0.844)	
post vote * EU8 national share					-0.180 (1.375)
Observations	12,766	12,766	12,766	12,766	12,766
Adjusted R-squared	0.976	0.976	0.976	0.976	0.976
TTWA FE	YES	YES	YES	YES	YES
Month-Year FE	YES	YES	YES	YES	YES

Notes: This table displays the results from the regressions of the log of monthly job postings by skill level in each TTWA on the average trade barrier exposure measures at the TTWA level interacted with the post vote dummy variable, with and without controls. All specifications include TTWA and month-year fixed effects, and standard errors (in parentheses) are two-way clustered at the TTWA and month-year level. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

**Table 3: Barrier exposure impacts by occupation**

Dep var: log SOC postings	1. Managers, Directors and Senior Officials	2. Professional Occupations	3. Associate Professional and Technical Occupations
post vote * prof services exposure	-0.551*** (0.130)	-0.798*** (0.146)	-0.532*** (0.149)
post vote * tariff exposure	-0.048 (0.046)	0.052 (0.053)	-0.032 (0.051)
	4. Administrative and Secretarial Occupations	5. Skilled Trades Occupations	6. Caring, Leisure and Other Service Occupations
post vote * prof services exposure	-0.017 (0.134)	-0.220 (0.153)	-0.173 (0.121)
post vote * tariff exposure	-0.049 (0.030)	-0.042 (0.035)	0.020 (0.038)
	7. Sales and Customer Service Occupations	8. Process, Plant and Machine Operatives	9. Elementary Occupations
post vote * prof services exposure	-0.243 (0.151)	-0.175 (0.157)	-0.173 (0.172)
post vote * tariff exposure	-0.050 (0.032)	-0.082** (0.040)	0.037 (0.075)
Observations	12,780	12,780	12,780
Adjusted R-squared	0.962	0.977	0.970
TTWA FE	YES	YES	YES
Month-Year FE	YES	YES	YES

Notes: This table displays the estimated coefficients on the services exposure variable from the regressions of the log of monthly job postings by occupation in each TTWA on the average trade barrier exposure measures at the TTWA level interacted with the post vote dummy variable. All specifications include TTWA and month-year fixed effects, the EU immigration control interacted with a post-vote dummy variable and standard errors (in parentheses) are two-way clustered at the TTWA and month-year level. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

tional category captures manufacturing workers, the exact group on which barriers to trade in goods would have the largest impact. The estimated magnitude is economically meaningful. A one standard deviation increase in exposure to tariffs corresponds to a -3.6% decline in job postings for this group.

## 5.4 Back-of-the-envelope calculation of aggregate effects

In order to provide a rough idea of what these results for professional services may have implied for the full sample, we follow [Chodorow-Reich \(2014\)](#) and carry out a back-of-the-envelope counterfactual exercise on our baseline results (considering only the direct effects). For each TTWA, we consider what the predicted values for monthly postings after the vote would have been had they been less exposed to barriers on professional services exports. This exercise relies on two simplifying assumptions. First, the total effects on postings equal the sum of the direct effects on postings at each TTWA. Second, TTWAs below the 10th percentile in terms of professional services exposure did not change their posting of job ads after

the vote in response to the threat of future service export barriers.

We define the counterfactual post-vote monthly postings of TTWA  $r$  had they had an exposure score in the  $\tau$ th percentile as:

$$\log \text{postings}_{rt}^{\tau} = E \left[ \log \text{postings}_{rt} \mid \text{exposure}_r = \text{exposure}_r^{\tau} \right] \quad (7)$$

$$= \log \widehat{\text{postings}}_{rt} + \hat{\beta} \left[ \text{exposure}_r^{\tau} - \text{exposure}_r \right] \quad (8)$$

where  $\hat{\beta}$  and  $\widehat{\text{postings}}_{rt}$  are the estimated coefficient and the fitted values from our baseline regression in column (4) of Table 1. Then the total monthly loss of postings due to the threat of trade barriers is:

$$\text{Total monthly loss}_t = \sum_{r: \text{exposure}_r > \text{exposure}_r^{\tau}} \left[ \exp(\log \text{postings}_{rt}^{\tau}) - \exp(\log \widehat{\text{postings}}_{rt}) \right] \quad (9)$$

This expression gives the total loss across all affected TTWAs in a single month  $t$ . Taking  $\tau$  of the 10th percentile as the counterfactual of a relatively unexposed TTWA, this exercise implies that after the vote the mean monthly decline, taken over TTWAs and months, in the number of job postings relative to this counterfactual of having limited exposure to professional services barriers was 164. Totalling across all TTWAs, each month there were on average 34,894 fewer job adverts posted than this counterfactual benchmark (calculated by averaging equation 9 over all months). The mean monthly number of job adverts posted prior to the vote across all TTWAs was 535,397, so this full sample effect implies a 6.5 percent loss in monthly job adverts on average after the vote for the full sample. Summing up over the whole post-vote period, this implies a cumulative loss of approximately 1.5 million job postings relative to what might have occurred had all TTWAs been unexposed to professional services export barriers.<sup>35</sup>

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<sup>35</sup>For reference, the size of the UK labour force is approximately 34 million.

## 6. Additional results and mechanisms

### 6.1 A focus on financial services

Financial services are of particular importance for the UK economy. This industry alone accounted for 42 percent of the professional services exports to the EEA in 2015. The financial services industry is also uniquely reliant on ‘passporting’ arrangements with the EU, which had a distinct and important role in the Brexit negotiations, as discussed earlier. The UK is relatively unique in collecting detailed data on the regional breakdown of services exports at the level of 11 NUTS1 regions. The ONS provides the value of services exports for aggregated services categories, of which financial services is one. This means that for financial services we can exploit additional regional variation in the export intensity, which is not possible for the other professional services.

First, we define exposure of financial services to export barriers taking into account NUTS1 variation in industry exports:

$$\text{Regional FS exposure}_{NUTS1} = \frac{\text{Regional FS Exports to EEA}_{NUTS1,2015}}{L_{FS,NUTS1,2015}} \times \text{avg STRI gap}_{FS,2014} \quad (10)$$

where  $\text{avg STRI gap}_{FS,2014}$  is the trade-weighted STRI gap for financial services,  $\text{Regional FS Exports to EEA}_{NUTS1,2015}$  are the exports of financial services from a given UK NUTS1 region to the EEA, and  $L_{FS,NUTS1,2015}$  is employment in financial services in a given NUTS1 region.

The exposure of a given TTWA  $r$  (belonging to a given *NUTS1* region) is then defined as:

$$\text{FS exposure}_{r,NUTS1} = \text{FS empl share}_{r,2015} \times \text{Regional FS exposure}_{NUTS1} \quad (11)$$

where  $\text{FS empl share}_{r,2015}$  is the financial service share of TTWA  $r$  employment in 2015.

Figure 9 in Online Appendix A displays a map illustrating geographic variation in the exposure measure, while Figure 10 lists the 15 most exposed TTWAs. The list is topped by London, Edinburgh, and Trowbridge. A number of the most exposed regions are home to banks or building societies, for example Skipton (4th most exposed) being home to Skipton Building Society, or Halifax (5th most exposed) being home to Halifax Building Society.

We estimate our baseline specification replacing the professional services exposure mea-

**Table 4:** Financial services post-vote baseline

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * financial services exposure	-1.201*** (0.296)	-1.201*** (0.295)	-1.225*** (0.302)	-1.211*** (0.293)	-1.208*** (0.300)
post vote * tariff exposure		-0.00271 (0.0328)	-0.0176 (0.0525)	-0.0179 (0.0523)	-0.0174 (0.0522)
export REER			-0.0981 (0.142)	-0.0985 (0.142)	-0.102 (0.142)
post vote * EU national share				-0.139 (0.926)	
post vote * EU8 national share					-0.589 (1.403)
Observations	12,780	12,780	12,780	12,780	12,780
Adjusted R-squared	0.984	0.984	0.984	0.984	0.984
TTWA FE	YES	YES	YES	YES	YES
Month-Year FE	YES	YES	YES	YES	YES

Notes: This table displays the results from the regressions of the log of monthly job postings in each TTWA on the average trade barrier exposure measures at the TTWA level interacted with the post vote dummy variable, with and without controls. All specifications include TTWA and month-year fixed effects, and standard errors (in parentheses) are two-way clustered at the TTWA and month-year level. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

sure with the newly defined measure focusing on just financial services. As visible in Table 4, we find negative and significant results across all specifications with coefficients varying from -1.201 to -1.208. Focusing on column (4), a one standard deviation increase in financial services exposure (0.0345) leads to a 4.2 percent decrease in monthly postings.

Figure 14 in the Online Appendix displays the estimates from the regression of job postings on the financial services exposure measure interacted with quarter dummies. The results are similar to those found earlier for the professional services and shown in Figure 6. As before, there is no evidence of pre-trends and the impact is delayed until Q2 2017 (ie the quarter following invocation of Article 50). As before, we also see a downward shift in the estimated coefficients after the publication of the Government’s White Paper in July 2018.

Table 11 in the Online Appendix also presents the financial services results broken down by skill level. As before, we find that the results are stronger for high skilled postings than for low skilled postings. When we break down the estimates by occupational groups (see Table 12 in the Online Appendix) the estimated coefficients of interest are strongly significant and negative for five out of the nine occupations. These are: Managers, Directors and Senior Officials, Professional Occupations, Associate Professional and Technical Occupations, Skilled Trades Occupations and Sales and Customer Service Occupations. The Skilled Trades Occupations group includes a range of occupations, such as electricians, IT engineers, con-

struction and building trades and even food preparation and hospitality trades, suggesting an effect on the business ecosystem serving the financial industry.

## 6.2 Relationship with unemployment

Online job adverts provide one proxy for the *flow* variable of the intent to hire employees, which could reflect either firm growth or the replacement of existing workers. Holding all other aspects of the labour market response constant, we would expect negative effects on online job adverts to feed through to affect total unemployment rates. Data on total employment at the TTWA level at a higher frequency than annually are not published in the UK, hence the advantage of studying online job postings. However, we can use estimates of quarterly unemployment rates in TTWAs as calculated using household survey data.

Figure 7 presents the results from an event study focusing on unemployment rates and estimated in a manner analogous to those for the online job adverts instead using data on unemployment rates as estimated from the APS, which is a continuous household survey that collects data on a range of social and socio-economic variables at local levels, and is described in Section 4.<sup>36</sup> We find that TTWAs that were more exposed to professional services barriers saw an increase in unemployment rates for three consecutive quarters beginning in Q3 2018, which closely matches the timing of the negative effect on online job adverts observed in the aftermath of the White Paper being published. However, the estimated effect on unemployment rates fluctuates quite a lot, with a statistically significant decline also for one quarter in Q2 2017 and again in Q4 2019.<sup>37</sup>

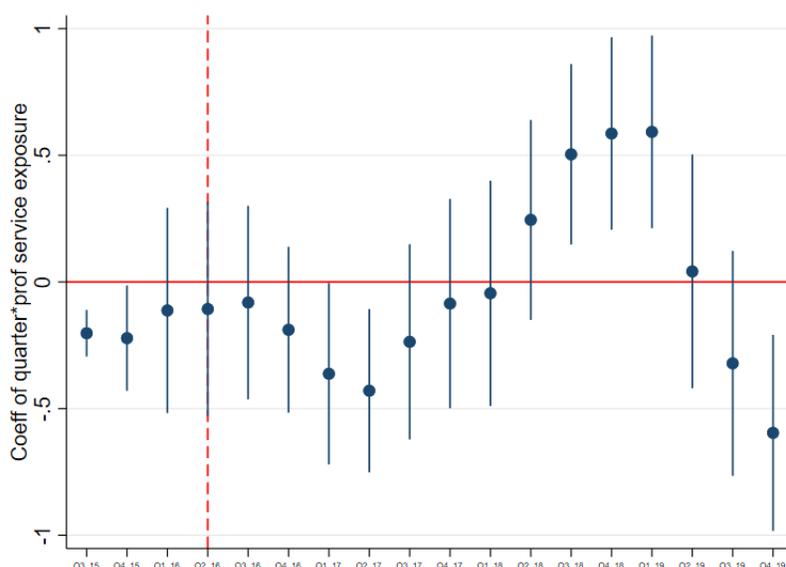
There are some alternative potential explanations for the relative decline in online job adverts in services barrier exposed regions after the referendum that we document in this paper. One possibility is that it could reflect a decline in workers changing jobs in response to the threat of barriers and hence firms needing to advertise less. Alternatively, it could represent a shift away from online hiring towards hiring offline. Neither of these would result in negative effects for employment. Data on total (online plus offline) vacancies and separations are not available at the TTWA level. However, aggregate data on estimates of nationwide job-to job

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<sup>36</sup>The unemployment rate is calculated by dividing the unemployment level for those aged from 16 to 64 by the economically active population for that age group.

<sup>37</sup>Results, displayed in Figure 16 in Online Appendix A are similar for financial services, with no evidence of any effects of tariff exposure or unemployment and only slight negative effects of the EU national share on unemployment in Q3 and Q4 of 2017.

Figure 7: Impact on unemployment



*Notes:* This graph shows the coefficients from the regression of the log of quarterly unemployment rates on the professional services exposure measure at the TTWA level, interacted with a dummy variable for each quarter from Q3 2015 to Q4 2019, controlling for the EU national share interacted with the post vote dummy variable, tariff exposure interacted with the post vote dummy variable, exposure to the export REER, TTWA fixed effects and quarter-year fixed effects. Coefficients are relative to the base period of Q1 2015 and Q2 2015. The dots represent the point estimates and the lines the 90 percent confidence intervals. The red line shows the quarter when the referendum occurred, Q2 2016.

changes, displayed in Figure 21 in Appendix D, does not suggest any decline in people changing jobs, but in fact a slight increase. Figure 19 in Appendix D discusses and displays data on total estimated vacancies for the economy as a whole. There is some, limited, evidence of a slight divergence between BGT online job adverts and the total vacancy figures estimated based on the UK Vacancy Survey (UKVS). However, as discussed in the Online Appendix, the UKVS data are partially imputed, so they are also subject to measurement error, and, moreover, this relatively small divergence could only explain a small part of the decline in online postings. Hence, neither of these explanations appear sufficient to explain our results. Taken together, these aggregate trends and the results we find for unemployment are suggestive of the relative decline in online postings in response to services export barriers feeding through to affect employment outcomes, at least to some degree.

### 6.3 A more flexible approach to geography

Our current local labour market approach analyses the direct effects of a particular TTWA's exposure to potential barriers on job postings within the same TTWA. In this section, we ex-

plore the impact of relaxing this geographical constraint and also evaluating the effects from neighbouring TTWAs. There are two main mechanisms for these spillovers beyond TTWA borders. First, if firms in a particular TTWA are hit by uncertainty surrounding future profits, they may reduce demand for the outputs of supplier firms, which could be located in the surrounding areas. This may, in turn, reduce labour demand at those firms. Second, if fewer people are employed in a given TTWA due to lower labour demand, the workers may reduce consumption, which could affect the surrounding localities. The presence and magnitude of these spillovers will depend on the economic linkages between TTWAs that are close in proximity.

In order to examine these potential effects, we construct new exposure variables which combine the direct and indirect effects of trade barrier exposure. Specifically, we construct a weighted sum of the exposures of all TTWAs, where the weights are the inverse distance between the TTWA of interest (the 'own province') and the surrounding TTWAs.<sup>38</sup> The results are presented in Panel (a) of Table 5. The professional services exposure coefficient is negative and statistically significant once controls are included (columns (3) and (4)).

We then split this variable up into two components: the baseline own province professional service exposure, and the spillovers not including own province. Panel (b) shows the results. The own province measure remains strongly negative and statistically significant, while the pure spillover measure is not significant. These results indicate that spillover effects of professional services do not play a major role in the labour market impacts of Brexit.

Turning to tariff measures, the coefficient for the aggregated spillovers measure in Panel (a) is negative and significant once controls are added in columns (3) and (4). Panel (b) shows this result is robust to the professional services exposure being split into its two sub-components. Panel (c) instead keeps the aggregated professional services spillover measure, but breaks down the tariff exposure into the baseline 'own province' exposure, and the pure spillover effect.<sup>39</sup> Our baseline result is confirmed: the coefficient of the direct own province tariff exposure remains non-significant. However, we now find negative and significant coefficients for the spillovers effects excluding own province. These results support the conclusion that, although professional services spillovers do not seem to exist, tariff exposure

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<sup>38</sup>We use half the radius of the own province for its own weight.

<sup>39</sup>We do not include the breakdown of both tariff and professional services in the same specification due to very high correlation between the two pure spillover measures.

Table 5: Spillover effects

Dep variable: log postings				
	Panel (a)			
	(1)	(2)	(3)	(4)
post vote * service barrier exposure spillover	-0.433 (0.425)	-0.171 (0.443)	-1.183** (0.474)	-1.308** (0.493)
post vote * tariff exposure spillover		-0.177 (0.146)	-0.564*** (0.207)	-0.559*** (0.205)
Observations	12,780	12,780	12,780	12,780
Adjusted R-squared	0.984	0.984	0.984	0.984
	Panel (b)			
post vote * service barrier exposure	-0.560*** (0.117)	-0.619*** (0.119)	-0.613*** (0.116)	-0.644*** (0.119)
post vote * service barrier exposure spillover (excl. own province)	0.124 (0.507)	0.837 (0.554)	-0.0674 (0.596)	0.764 (0.792)
post vote * tariff exposure spillover		-0.369** (0.151)	-0.617*** (0.208)	-0.651*** (0.202)
controls				
Observations	12,780	12,780	12,780	12,780
Adjusted R-squared	0.984	0.984	0.984	0.984
	Panel (c)			
post vote * tariff exposure spillover	0.006 -0.029	0.007 -0.028	-0.025 -0.042	-0.023 -0.042
post vote * tariff exposure spillover (excl. own province)	-0.327 (0.210)	-0.364* (0.209)	-0.853*** (0.259)	-0.851*** (0.257)
post vote * service barrier exposure		0.0897 (0.469)	-0.804 (0.491)	-0.970* (0.491)
controls				
Observations	12,780	12,780	12,780	12,780
Adjusted R-squared	0.984	0.984	0.984	0.984

Notes: This table displays the results from the regressions of the log of monthly job postings in each TTWA on the average trade barrier exposure measures interacted with the post vote dummy variable, with and without controls. Columns (1) and (2) include no additional controls. Column (3) includes a control for the exchange rate and column (4) additionally controls for share of EU workers. All specifications include TTWA and month-year fixed effects, and standard errors (in parentheses) are two-way clustered at the TTWA and month-year level. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

spillovers exist and are negative.

The difference in results when comparing goods and services barriers may be related to the different levels of integration in local value chains. Goods often require inputs which are costly to transport and hence national economic linkages may prioritise sourcing from closer producers. As a result, the effects from spillovers of closer TTWAs are larger. Services tend to require fewer or no inputs, and can often be delivered at distance, so are not subject to the same spillover effects.

## 6.4 Uncertainty

Our baseline specification uses a difference-in-differences specification, comparing the post-referendum to the pre-referendum period. However, three and a half years passed between the Brexit referendum and the UK officially leaving the EU on the 31st January 2020. This period was characterised by a long and varying political process, including three general

elections, two changes of Prime Minister and three extensions to the date when the UK would officially leave the EU. Businesses were left to adjust to regular changes in the implications of the proposed arrangements.

We therefore also explore how the impact of exposure to barriers to service exports or future MFN tariffs varied during the post-vote period in response to the changing levels of uncertainty around negotiation outcomes. We estimate the following specification:

$$\log(\text{postings}_{rt}) = \beta_0 + \beta_1 \text{trade barrier threat}_r \times \text{uncertainty}_t + \gamma_t + \gamma_r + \epsilon_{rt} \quad (12)$$

where  $\text{uncertainty}_t$  is one of four measures of uncertainty pertaining to month-year  $t$ . This specification is applied to the negotiation period starting in September 2016, which is the first date for which the Brexit Uncertainty Index (BUI) is available.<sup>40</sup>

We make use of two existing measures of Brexit-related uncertainty: the Brexit Uncertainty Index (BUI) developed by [Bloom et al. \(2019\)](#) and the Brexit Risk index developed by [Hassan et al. \(2020\)](#). We then construct two new measures of trade-specific policy uncertainty, using the intensity with which newspaper articles and Google searches in the UK included terms relating to both Brexit and trade policy. [Appendix C](#) provides more detail on their construction along with a short discussion on uncertainty versus expectations.

[Table 6](#) presents the results for four uncertainty indices. Each specification includes the full set of controls, alternating between the EU national share and EU8 national share.

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<sup>40</sup>By excluding July 2016 from the analysis, we avoid the impact of the immediate aftermath of the vote, when uncertainty spiked due to the surprising nature of the result.

**Table 6: Uncertainty measure results**

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	BUI		Brexit Risk		Google		Newspaper	
measure*service barrier exposure	-0.034*** (0.007)	-0.040*** (0.007)	-0.141*** (0.050)	-0.172*** (0.051)	-0.232*** (0.058)	-0.269*** (0.060)	-0.066* (0.039)	-0.082* (0.042)
measure *tariff exposure	-0.001 (0.002)	0.000 (0.002)	0.005 (0.010)	0.011 (0.010)	-0.007 (0.011)	-0.001 (0.011)	0.009 (0.006)	0.012* (0.006)
measure*EU national share	-0.264*** (0.042)		-1.585*** (0.281)		-1.907*** (0.349)		-0.826*** (0.239)	
measure*EU8 national share		-0.414*** (0.062)		-2.394*** (0.414)		-2.901*** (0.523)		-1.246*** (0.399)
export REER	0.390 (0.369)	0.410 (0.376)	0.124 (0.404)	0.148 (0.411)	0.342 (0.394)	0.346 (0.398)	0.367 (0.413)	0.356 (0.415)
Observations	8,520	8,520	6,603	6,603	8,520	8,520	8,520	8,520
Adjusted R-squared	0.987	0.987	0.988	0.988	0.987	0.987	0.987	0.987
TTWA FE	YES							
Month-Year FE	YES							

Notes: This table displays the results from the regressions of the log of monthly job postings in each TTWA on the average trade barrier exposure measures at the TTWA level interacted with varying uncertainty measures. The post vote period from September 2016 to December 2019 is considered. All specifications include TTWA and month-year fixed effects, and standard errors (in parentheses) are two-way clustered at the TTWA and month-year level. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

As before, the coefficients on interactions with professional services exposure are negative and statistically significant in all specifications. They reach a one percent significance level for the Google, BUI and Brexit Risk indices, whereas the estimates for the newspaper index are statistically significant only at the 10 percent level. Coefficients are generally larger in magnitude when controlling for the exposure to EU8 migrants. Taking the Google index as an example (column (5)), an increase in uncertainty from the 25th to the 75th percentile (1.13 to 2.25) leads to a 3.3 percent decrease in monthly postings for the mean value of the services barrier exposure measure (0.127). The corresponding effect for the BUI measure is a decrease of 6.3 percent, for the Brexit Risk measure a decrease of 1.4 percent and for the Newspaper measure a decrease of 1.8 percent.<sup>41</sup>

As before we find that interactions with exposure to tariffs remain insignificant across 7 out of 8 specifications, confirming the view that businesses did not appear to be adjusting hiring as a response to a threat of tariffs.

## 7. Robustness and extensions

We next present a brief overview of various robustness checks and extensions, with more details provided in the Online Appendix.

<sup>41</sup>The larger effect for BUI may be linked to the fact that it measures when Brexit becomes one of firms' top three causes of uncertainty, while the others do not attempt to capture the severity of uncertainty relative to other causes.

## 7.1 Placebo test

One potential concern could be that our baseline pre-post results are driven by time varying unobservables that are not absorbed by month-year fixed effects, and so we conduct a further placebo test. Here we limit the data to only 2015 and split the sample into a pre- and post-period with six months in each. In other words, we introduce a break in mid-2015 instead of using the actual timing of the referendum, which took place in June 2016. We then interact a post-June 2015 dummy with the professional services exposure. Table 13 presents the results of this alternative placebo test using pre-referendum postings. The coefficients are not significant across all specifications, suggesting that this impact was not observed prior to the referendum.

## 7.2 Excluding London

Another concern is that the estimated impact was primarily driven by London. First, Figures 3 and 8 show that the professional services exposure is actually not as concentrated in London as is often presumed. Additionally, Table 14 in Online Appendix B repeats the analysis in Table 1 but excludes the TTWA of London. The resulting coefficients are extremely close to the baseline case, allowing us to conclude that London is not driving the results. Financial services exposure is also spread more evenly across the country more than is typically presumed, as is shown in Figure 9 of Online Appendix A. Excluding London also does not have much impact on the results for financial services exposure.

## 7.3 Including trade and employment shares

A further concern is that our results are driven mainly by the shares in our exposure measure, rather than variation in the STRI or tariff component across sectors (the 'shift'). We therefore control for these shares for both the professional services measure and the tariff measure. The shares are constructed by a combination of the TTWA-sector employment weightings, and the sectoral exports to employment ratio, i.e excluding the trade weighted STRI or tariff component of the exposure measures.

Table 15 in Online Appendix B repeats the baseline analysis but includes these shares. The professional services measure remains significant across all specifications, while the associ-

ated share is positive and significant at the 10 percent level in 4 out of the 5 specifications. This suggests that while professional services sectors that exported a lot to the EU were increasing their job postings, those which were more exposed to higher potential trade barriers experienced a relative decline in postings. To interpret the magnitude of the professional services coefficient in this specification, we fix the professional services share at its mean (0.82) and consider a one standard deviation increase in the sectoral STRI exposure (0.058) which leads to a 16 percent relative decline in monthly postings. Figure 15 in the Online Appendix also repeats the event study for professional services, including these shares, demonstrating qualitatively similar results with negative statistically significant impacts felt from Q2 2018 when shares are included.

## 7.4 Alternative measures of tariff exposure

There are a range of ways in which tariff exposure has been measured in the literature. Table 16 presents our baseline results using four alternative tariff exposure measures. Columns (1) and (2) use the ‘output weighted’ tariff exposure. Instead of weighting by sectoral exports per worker, this measure weights by the fraction of EU exports in total sectoral output.<sup>42</sup> The exposure used in columns (3) and (4) removes this weighting altogether, leaving a simple export weighted average tariff normalised by neither total employment nor total output. Columns (5) and (6) first take  $\ln(1+\text{MFN tariff}_p)$  before applying weightings but otherwise use the same construction as the baseline measure. Finally, columns (7) and (8) adapt the baseline by replacing 4-digit national exports by 2-digit regional exports in the weighting. These results suggest that these different formulations of the tariff exposure measure do not significantly change the conclusions from our baseline results.

## 7.5 Non-tariff barriers, specific tariffs and quotas

Although tariffs are the most conspicuous trade barrier for goods, NTBs may also matter for trade in goods. In order to investigate this possibility we create a new measure of regional exposure to NTBs on exports of goods to the EU. The measure is constructed in an identical way to the baseline tariff exposure measure but with tariffs replaced by a product-level NTB

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<sup>42</sup>Due to data limitations, this weighting is at the 2-digit ISIC level and is sourced from the UK’s Office of National Statistics input-output tables for 2014.

exposure. We use data from WITS, which provides a list of MFN non-tariff barriers at the 8-digit HS level. We first count how many barriers each HS8 product would be exposed to under MFN terms and then take a simple average at the HS6 level to match with our Comtrade export data. This measure is then weighted by each product's share of exports to the EU before replacing the avg MFN tariff<sub>j,2014</sub> in equation 4. Table 17 presents the results, NTB exposure is not statistically significant in any specification.

In addition to ad valorem tariffs, calculated as a percentage of the good's value, there are also relevant non-ad valorem tariffs. Two key cases are specific tariffs, computed on the physical quantity of the good being imported, and tariff-rate quotas, made up of a low or zero tariff rate on an initial quantity of imports (the within-quota quantity) and a very high tariff rate on imports entering above that initial amount. Following Crowley et al. (2018a), we use data from WTO Tariff Analysis Online to calculate similar tariff threat measures for the EU MFN specific tariffs and quotas that would be applied under a no deal, specifically creating trade weighted averages of dummies indicating whether a particular product has a specific tariff, a quota, or either of the two.<sup>43</sup> We then include three weighted average measures for each of these three trade barriers as a robustness check on our results. Table 18 presents the baseline results with these measures included, demonstrating that including these measures has very little impact on our results.

## 7.6 Import tariffs

We also consider whether the potential of UK tariffs on imports from the EU under a no deal scenario had an impact on postings.<sup>44</sup> We construct two measures, one accounting for protection of UK industries from international competition, and the other accounting for the increase cost of imported industries for UK firms, with more details provided in Online Appendix C. The results displayed in Table 19 demonstrate that we find no effect of potential import tariffs on job adverts throughout the negotiation period.

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<sup>43</sup>WTO Tariff Analysis Online: [https://www.wto.org/english/tratop\\_e/tariffs\\_e/tariff\\_data\\_e.htm](https://www.wto.org/english/tratop_e/tariffs_e/tariff_data_e.htm)

<sup>44</sup>As discussed in Section 4 it is not possible to do the same for services imports due to the UK not being included in the Intra-EEA STRI.

## 8. Conclusion

This paper evaluates how the threat of future trade barriers on UK exports of both services and goods to the EU affected the posting of online job adverts throughout the Brexit negotiation period from January 2015 to December 2019. We exploit *ex ante* variation in the regulatory 'gap' between the stringent restrictions UK services exporters would face as a result of leaving the EU without a trade deal and reverting to GATS terms, and the minimal restrictions they faced while the UK was part of the EU, across industries and export partners. Using this regulatory 'gap' we construct measures of local labour market exposure to the threat of future services barriers introduced by the referendum outcome. We also construct an analogous measure for goods exports based on the threat of EU MFN tariffs.

We find that the threat of trade barriers on professional services exports to the EU had a large negative effect on the posting of online job adverts after the Brexit referendum. A one standard deviation increase in local labour market exposure to future services export barriers decreased monthly postings by 5 percent on average in the post-referendum period. A back-of-the-envelope counterfactual calculation suggests that the aggregate impact of this exposure across all TTWAs implies a cumulative 1.5 million postings lost between July 2016 and December 2019, relative to what would have occurred in the absence of the threat of these export barriers.

Using an event study design, we show that this negative impact was first detected in Q2 2017, which is right after the invocation of Article 50, i.e. the formal initiation of the process of leaving the EU. The magnitude of the estimated impact further intensifies in Q3 2018, just after the publication of the UK Government's Brexit White Paper spelling out its intentions to leave the Single Market and accept barriers to services exports.

We find that the threat of professional services export barriers affected the posting of both lower and higher skilled job adverts, although the magnitude was much larger for the latter. We explore the impact of barriers to financial services exports specifically, finding strong negative impacts of exposure to EU-export intensive financial service exports on the posting of job adverts, that also affected higher skilled job adverts more than lower skilled adverts. We show that these results all hold when additionally controlling for other key channels through which the vote could have affected labour markets, including the exchange rate depreciation following the referendum and immigration policy uncertainty.

The threat of future tariffs on goods exports to the EU did not have an effect on online job adverts after the referendum in our baseline specification. However, there are two exceptions: (i) when we explore the impacts on job adverts by occupation type, we find negative effects on postings for the occupation category corresponding to plant and machine operators only, and (ii) we find evidence suggesting that tariffs do matter when we no longer focus only on job adverts in the same local labour market only but augment the analysis to also take into account a larger geographic area, studying effects in all other TTWAs weighted by inverse distance. These results for export tariffs could relate to the supply chain linkages of manufacturing firms, where shocks may have been passed on to suppliers and so indirect effects are present, even if no direct effects were felt.

There are two possible explanations for the absence of direct effects of export tariffs. One is that while MFN tariffs in some cases can be large, 63 percent of HS-6-digit product lines would have tariffs below 5 percent. These tariffs would cut away at profitability but may not be game-changing in a way that some restrictions on services exports, such as revoking passporting rights, or requiring commercial presence to export engineering or legal services to certain EU countries that were previously major trade partners, could be. Moreover, manufacturing as a whole represents a relatively small share of UK employment (9.6 percent in 2015), and so impacts on the manufacturing sector may also not be large enough to show up when studying direct local labour market outcomes.

Taken together, we conclude that a retreat from deep integration can have important economic consequences in advanced economies that rely heavily on services trade. The mere threat of the introduction of services trade barriers had substantial, and relatively overlooked, effects on UK labour markets during the Brexit negotiation period through the reduced advertising of job openings, particularly for highly skilled professional and managerial roles, which are generally seen as high-quality jobs. By contrast, despite the greater prominence of tariffs and goods supply chains in the public debate on the economic impacts of Brexit, the threat of tariffs on goods exports played a far more muted role in impacting online job postings.

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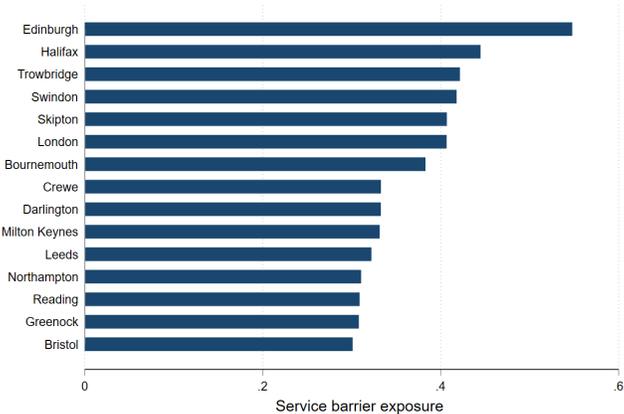
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# Online Appendix (Not for publication)

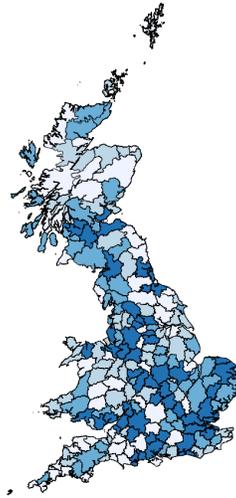
## A. Additional maps and figures

Figure 8: Most exposed Travel to Work Areas: professional services trade barriers



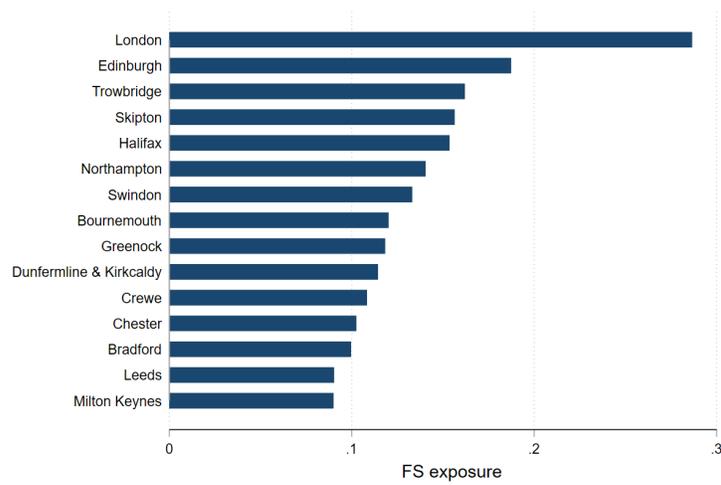
Notes: This chart presents the employment-weighted professional services exposure for the top 15 most exposed TTWAs. Sources: OECD, UN Comtrade.

Figure 9: Financial service exposure map



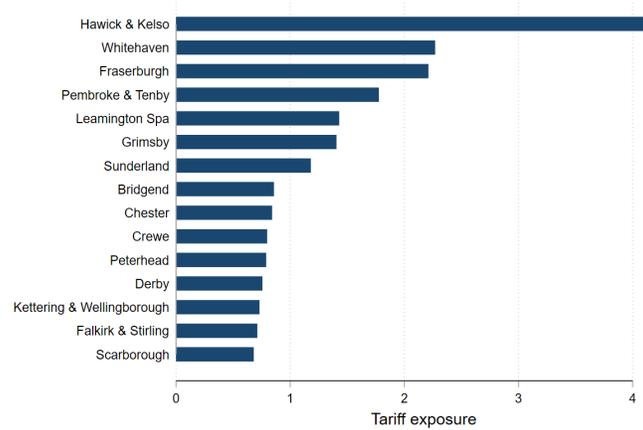
Notes: This map displays the measure of exposure to financial services trade barriers by TTWA. Areas with darker blue had a higher employment share in 2015 in sectors more exposed to potential future trade barriers on financial services exports to the EU.

Figure 10: Most exposed TTWAs: Financial Services



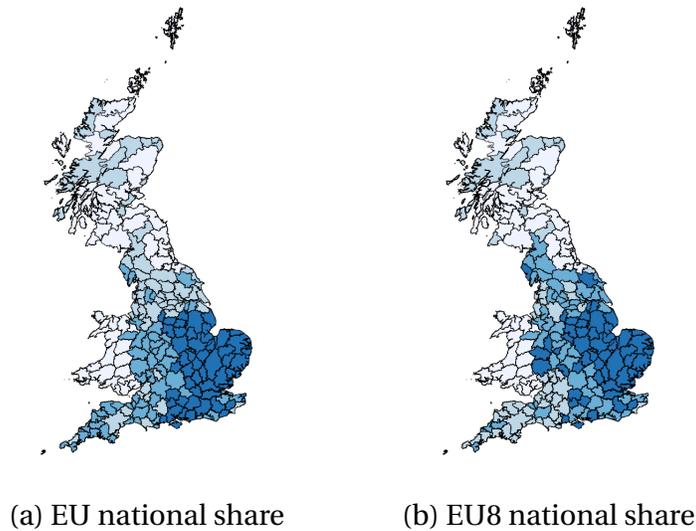
Notes: This chart presents the employment-weighted financial services exposure measures for the top 15 most exposed TTWAs.

**Figure 11: Most exposed Travel to Work Areas: Tariff Barriers**



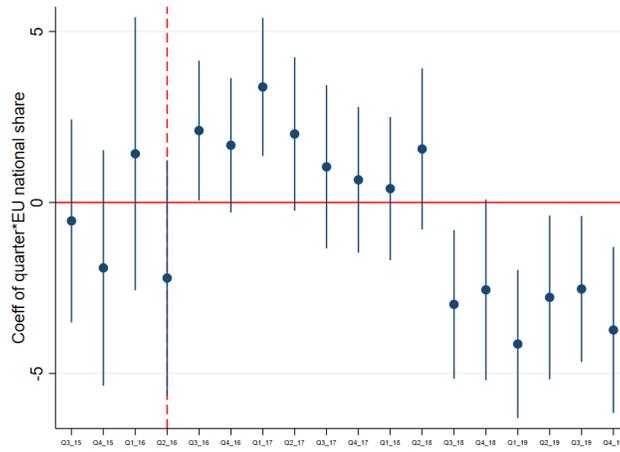
Notes: This graph displays the MFN tariff threat for the 15 most exposed TTWAs. Sources: World Integrated Trade Solution (WITS), UN Comtrade.

**Figure 12: Exposure to immigration**

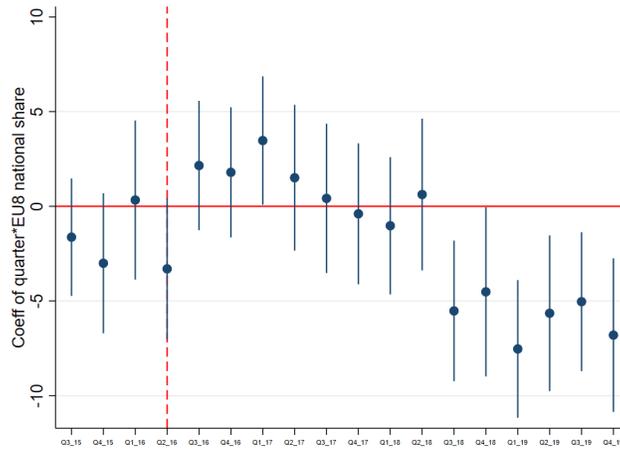


Notes: Panel (a) displays the 2015 employment share of EU nationals, areas with darker blue had a higher share. Panel (b) displays the share of EU8 nationals, areas with darker blue had a higher share.

Figure 13: Impact of EU immigration exposure over time



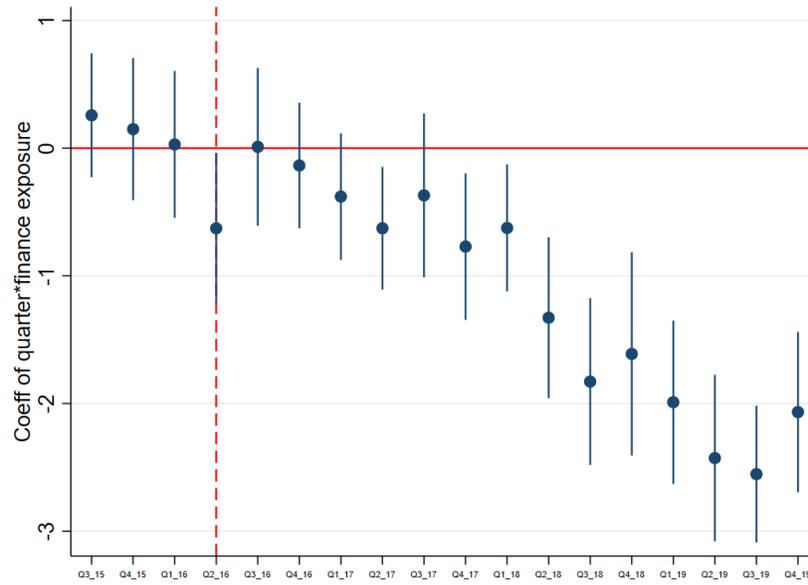
(a) EU national share



(b) EU8 national share

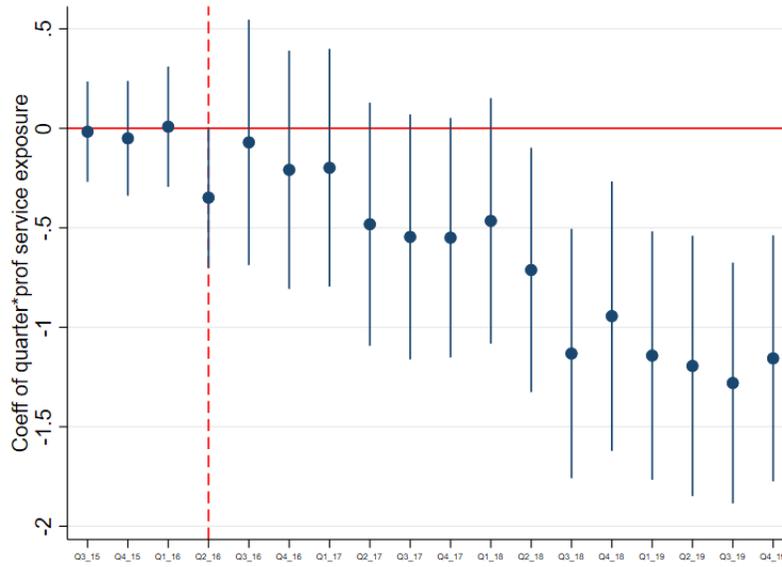
*Notes:* This graph shows the coefficients from the regressions of the log of monthly job postings on the EU immigration exposure measure interacted with a dummy variable for each quarter from Q3 2015 to Q4 2019. Coefficients are relative to the base period of Q1 2015 and Q2 2015. The regressions also controlled for the professional services and tariff exposure measures interacted with the post vote dummy variables and the exchange rate control, TTWA fixed effects and month-year fixed effects, and standard errors are two-way clustered at the TTWA and month-year level. The dots represent the point estimates and the lines the 90 percent confidence intervals. The red line shows the quarter when the referendum occurred, Q2 2016.

Figure 14: Impact of financial services exposure over time



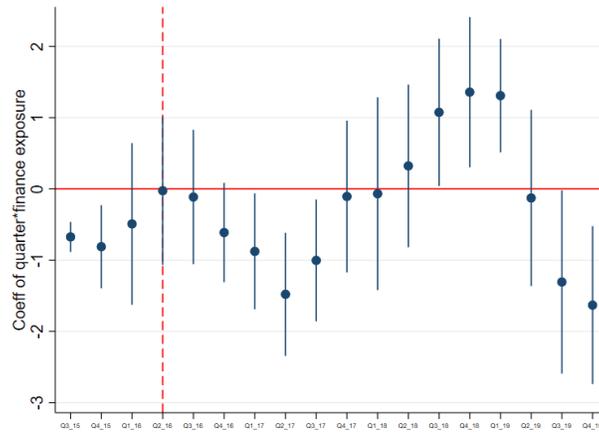
*Notes:* This graph shows the coefficients from the regressions of the log of monthly job postings on the financial services exposure measure interacted with a dummy variable for each quarter from Q3 2015 to Q4 2019. Coefficients are relative to the base period of Q1 2015 and Q2 2015. The regressions also controlled for the EU immigrant share and tariff exposure interacted with the post vote dummy variables, the exchange rate control, TTWA fixed effects and month-year fixed effects, and standard errors are two-way clustered at the TTWA and month-year level. The dots represent the point estimates and the lines the 90 percent confidence intervals. The red line shows the quarter when the referendum occurred, Q2 2016.

Figure 15: Impact of professional services exposure with share controls

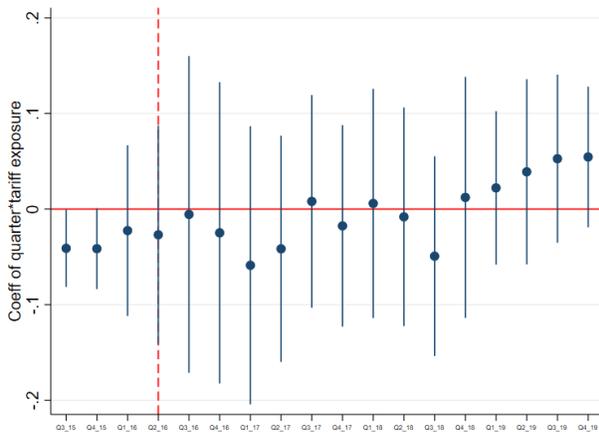


*Notes:* This graph shows the coefficients from the regressions of the log of monthly job postings on the professional services exposure measure interacted with a dummy variable for each quarter from Q3 2015 to Q4 2019. Coefficients are relative to the base period of Q1 2015 and Q2 2015. The regressions also controlled for the trade and employment shares, the EU immigrant share and tariff exposure interacted with the post vote dummy variables, the exchange rate control, TTWA fixed effects and month-year fixed effects, and standard errors are two-way clustered at the TTWA and month-year level. The dots represent the point estimates and the lines the 90 percent confidence intervals. The red line shows the quarter when the referendum occurred, Q2 2016.

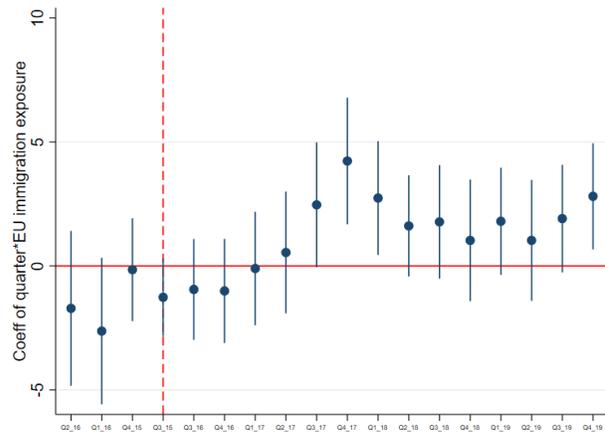
Figure 16: Impact on unemployment



(a) Financial services exposure



(b) Tariff exposure



(c) EU share

*Notes:* These graphs show the coefficients from the regression of the log of quarterly unemployment rates on the exposure measures at the TTWA level interacted with a dummy variable for each quarter from Q3 2015 to Q4 2019. Panels a and b also control for the EU national share interacted with the post vote dummy variable, tariff exposure interacted with the post vote dummy variable, exposure to the export REER, TTWA fixed effects and quarter-year fixed effects. Panels c and d additionally control for professional services exposure interacted with the post-vote dummy. Coefficients are relative to the base period of Q1 2015 and Q2 2015. The dots represent the point estimates and the lines the 90 percent confidence intervals. The red line shows the quarter when the referendum occurred, Q2 2016.

## B. Additional tables

Table 7: Brexit timeline

Date	Event
23rd Jan 2013	Prime Minister David Cameron declares he is in favour of an EU referendum
14th Apr 2015	Launch of the Conservative Party Manifesto for the 2015 General Election, committing to 'hold an in-out referendum on our membership of the EU before the end of 2017'
7th May 2015	Election of Cameron on Manifesto containing referendum promise
7th Sep 2015	European Union Referendum Act passed in parliament
20th Feb 2016	Date of referendum confirmed
<b>23rd Jun 2016</b>	<b>Brexit Referendum</b>
13th Jul 2016	Cameron steps down, Theresa May becomes Prime Minister
<b>29th Mar 2017</b>	<b>Invocation of Article 50</b>
8th June 2017	Snap General Election, Conservative party remains largest party but loses seats, relying on Democratic Unionist Party for majority in Parliament
20th Nov 2017	Michel Barnier states "The legal consequence of Brexit is that the UK providers lose their EU passport"
<b>12th Jul 2018</b>	<b>UK Government publishes its White Paper ruling out mutual recognition as preferred option for financial services sector</b>
14th Nov 2018	The Withdrawal Agreement is agreed and published
25th Nov 2018	EU27 leaders endorse the withdrawal agreement and approve political declaration on future EU-UK relations
15th Jan 2019	First failed vote on withdrawal deal in UK Parliament
16th Jan 2019	UK Government wins vote of no confidence
12th Mar 2019	Second failed vote on withdrawal deal in UK Parliament
14th Mar 2019	Vote to request extension of Article 50 in UK Parliament (to 12th April if no deal agreed or 22nd May if deal agreed)
29th Mar 2019	Third failed vote on withdrawal deal in UK Parliament and originally planned leaving date
10th Apr 2019	The UK and EU27 agree to extend Article 50 until 31st October 2019
24th May 2019	May gives official notice of her resignation
24th Jun 2019	Boris Johnson elected Prime Minister by conservative party members
19th Oct 2019	New Brexit deal lost on amendment in the Commons, Prime Minister writes to European Council president to request another extension
12th Dec 2019	Johnson wins majority in the UK General Election
23th Jan 2020	European Union (Withdrawal Agreement) Act received Royal Assent
31st Jan 2020	UK leaves the European Union and enters transition period, due to run until end of 2020

Notes: This table shows the timeline of the events leading to the UK's exit from the European Union.  
Sources: Commons Briefing papers CBP-7960, Nigel Walker, <https://commonslibrary.parliament.uk/research-briefings/cbp-7960/>.

Table 8: Summary statistics

Variables	Mean	Median	Min.	Max.	Std Dev.
<i>Job postings:</i>					
Monthly postings	2,442	668	1	206,743	10,225
Monthly postings - low skilled	775	265	1	48,718	2,449
Monthly postings - high skilled	1,614	388	1	151,708	7,525
Monthly postings - SOC1	254	56	0	28,761	1,342
Monthly postings - SOC2	793	182	0	74,155	3,828
Monthly postings - SOC3	416	94	0	40,616	1,944
Monthly postings - SOC4	211	57	0	17,181	811
Monthly postings - SOC5	150	54	0	8,505	428
Monthly postings - SOC6	143	58	0	7,742	418
Monthly postings - SOC7	223	66	0	16,004	762
Monthly postings - SOC8	82	32	0	2,788	173
Monthly postings - SOC9	115	45	0	6,916	313
<i>Exposure measures:</i>					
Professional services exposure	0.127	0.0877	0.0323	0.548	0.0902
Financial services exposure	0.0335	0.021	0.00814	0.287	0.0346
Export tariff exposure	0.305	0.208	0.0204	4.2	0.412
Import tariff exposure	0.598	0.408	0.0423	5.52	0.732
Imported inputs tariff exposure	0.23	0.203	0.0671	0.775	0.11
<i>Controls:</i>					
Xrate impact via exports	1.64	1.50	0.60	8.36	0.73
EU national share	0.0465	0.0444	0.0182	0.144	0.0172
EU8 national worker share	0.0297	0.0274	0.0121	0.0624	0.0106
<i>Uncertainty indices:</i>					
Newspaper-based uncertainty index	4.33	4.12	2.16	7.15	1.45
Google-search-based uncertainty index	2.13	1.9	1.13	4.55	0.788
Brexit uncertainty index	44.3	39.2	34.8	58.3	7.79
Risk sentiment index	1.42	1.10	0.35	4.16	1.11
Sentiment index	0.68	0.55	-0.72	2.41	0.86

Notes: This table displays summary statistics for all of the key variables used in the analysis. The dataset includes a total of 213 TTWAs, across 60 months (Jan 2015 - Dec 2019), totalling 12,780 observations. All uncertainty measures run from Sept 2016 - Dec 2019. SOC refers to the standard occupational classification, with more detail presented in Table 10. The newspaper uncertainty index has been scaled by 100 so the mean of 4.33 represents 433 articles per month.

**Table 9: Mapping between UK SIC, OECD STRI & ONS Service export product types**

UK SIC 2007 code	STRI sector	ONS service product type
692	Accounting	Accountancy, auditing, bookkeeping and tax consulting services
691	Legal	Legal services
61	Telecom	Telecommunication services
62	Computer	Computer services
63	Computer	Information services
7111	Architecture	Architectural services
7112	Engineering	Engineering services
65	Commercial banking	Financial services
64	Insurance	Insurance services

Notes: This table displays the UK SIC codes with their mapped OECD STRI sectors and ONS product categories used to construct the professional service barrier threat measures.

**Table 10: Posting occupations and skill levels**

SOC Code	Group title	Skill grouping
1	Managers, Directors and Senior Officials	3/4
2	Professional Occupations	4
3	Associate Professional and Technical Occupations	3
4	Administrative and Secretarial Occupations	2
5	Skilled Trades Occupations	3
6	Caring, Leisure and Other Service Occupations	2
7	Sales and Customer Service Occupations	2
8	Process, Plant and Machine Operatives	2
9	Elementary Occupations	1

Notes: Where a skill grouping of 4 is the highest skill level and 1 is the lowest as defined by the ONS. Our definition of high skill includes levels 3 and 4, and low skill includes 1 and 2. Notes: ONS Standard Occupational Classification.

Table 11: Financial services impact by skill group

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
Panel (a) High skill					
post vote * financial services exposure	-1.414*** (0.322)	-1.414*** (0.323)	-1.427*** (0.327)	-1.414*** (0.319)	-1.405*** (0.329)
post vote * tariff exposure		0.015 (0.032)	0.007 (0.048)	0.007 (0.048)	0.008 (0.048)
export REER			-0.054 (0.130)	-0.054 (0.130)	-0.059 (0.130)
post vote * EU national share				-0.128 (0.938)	
post vote * EU8 national share					-0.773 (1.424)
Observations	12,773	12,773	12,773	12,773	12,773
Adjusted R-squared	0.982	0.982	0.982	0.982	0.982
Panel (b) Low skill					
post vote * financial services exposure	-0.662** (0.275)	-0.662** (0.274)	-0.681** (0.278)	-0.697** (0.264)	-0.680** (0.270)
post vote * tariff exposure		-0.014 (0.037)	-0.026 (0.054)	-0.026 (0.054)	-0.026 (0.055)
export REER			-0.076 (0.139)	-0.075 (0.139)	-0.076 (0.139)
post vote * EU national share				0.165 (0.885)	
post vote * EU8 national share					-0.010 (1.383)
Observations	12,766	12,766	12,766	12,766	12,766
Adjusted R-squared	0.976	0.976	0.976	0.976	0.976
TTWA FE	YES	YES	YES	YES	YES
Month-Year FE	YES	YES	YES	YES	YES

Notes: This table displays the results from the regressions of the log of monthly job postings by skill level in each TTWA on the average trade barrier exposure measures interacted with the post vote dummy variable, with and without controls. All specifications include TTWA and month-year fixed effects, and standard errors (in parentheses) are two-way clustered at the TTWA and month-year level. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

**Table 12: Financial services impact by occupation**

Dep var: log SOC postings	1. Managers, Directors and Senior Officials	2. Professional Occupations	3. Associate Professional and Technical Occupations
post vote * FS exposure	-1.397*** (0.327)	-1.537*** (0.376)	-1.225*** (0.332)
post vote * tariff exposure	-0.0372 (0.0442)	0.0693 (0.0503)	-0.0210 (0.0489)
export REER	-0.137 (0.179)	0.146 (0.141)	-0.100 (0.146)
post vote * EU national share	0.728 (0.906)	-0.979 (0.990)	0.152 (1.031)
	5. Skilled Trades Occupations	7. Sales and Customer Service Occupations	4. Administrative and Secretarial Occupations
post vote * FS exposure	-0.942*** (0.316)	-0.775** (0.317)	-0.294 (0.272)
post vote * tariff exposure	-0.0394 (0.0340)	-0.0461 (0.0317)	-0.0503* (0.0296)
export REER	-0.283 (0.192)	-0.0686 (0.154)	-0.282** (0.118)
post vote * EU national share	2.469** (0.977)	0.872 (0.954)	0.731 (0.942)
	6. Caring, Leisure and Other Service Occupations	8. Process, Plant and Machine Operatives	9. Elementary Occupations
post vote * FS exposure	-0.271 (0.321)	-0.529 (0.343)	-0.398 (0.367)
post vote * tariff exposure	0.0236 (0.0379)	-0.0788** (0.0393)	0.0407 (0.0740)
export REER	0.0917 (0.121)	-0.222 (0.150)	0.1000 (0.185)
post vote * EU national share	-1.285 (0.968)	2.182** (0.898)	0.682 (1.018)
Observations	12,780	12,780	12,780
TTWA FE	YES	YES	YES
Month-Year FE	YES	YES	YES

Notes: This table displays the results from the regressions of the log of monthly job postings by occupation in each TTWA on the average trade barrier exposure measures at the TTWA level interacted with the post vote dummy variable. All specifications include TTWA and month-year fixed effects, and standard errors (in parentheses) are two-way clustered at the TTWA and month-year level. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Table 13: Pre-vote placebo for 2015

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * service barrier exposure	-0.037 (0.176)	-0.027 (0.172)	-0.004 (0.166)	0.049 (0.148)	0.001 (0.161)
post vote * tariff exposure		0.044 (0.040)	0.069* (0.032)	0.065* (0.030)	0.071* (0.033)
export REER			-0.800* (0.405)	-0.783* (0.425)	-0.757 (0.428)
post vote * EU national share				-2.269 (1.296)	
post vote * EU8 national share					-2.353 (2.152)
Observations	2,556	2,556	2,556	2,556	2,556
Adjusted R-squared	0.985	0.985	0.986	0.986	0.986
TTWA FE	YES	YES	YES	YES	YES
Month-Year FE	YES	YES	YES	YES	YES

Notes: This table displays the results from the regressions of the log of monthly job postings in each TTWA on the average trade barrier exposure measures at the TTWA level interacted with the post dummy variable, with and without controls. The period considered is 2015 and the post dummy takes value one for months July-December. All specifications include TTWA and month-year fixed effects, and standard errors (in parentheses) are two-way clustered at the TTWA and month-year level. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Table 14: Baseline excluding London

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * service barrier exposure	-0.539*** (0.135)	-0.541*** (0.135)	-0.560*** (0.137)	-0.558*** (0.134)	-0.563*** (0.139)
post vote * tariff exposure		-0.008 (0.033)	-0.029 (0.055)	-0.029 (0.055)	-0.029 (0.054)
export REER			-0.136 (0.146)	-0.137 (0.146)	-0.143 (0.146)
post vote * EU national share				-0.327 (1.002)	
post vote * EU8 national share					-0.929 (1.426)
Observations	12,780	12,780	12,780	12,780	12,780
Adjusted R-squared	0.984	0.984	0.984	0.984	0.984
TTWA FE	YES	YES	YES	YES	YES
Month-Year FE	YES	YES	YES	YES	YES

Notes: This table displays the results from the regressions of the log of monthly job postings in each TTWA on the average trade barrier exposure measures at the TTWA level interacted with the post vote dummy variable, with and without controls. All specifications include TTWA and month-year fixed effects, and standard errors (in parentheses) are two-way clustered at the TTWA and month-year level. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Table 15: Including shares

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * service barrier exposure	-4.287** (1.972)	-4.216** (1.974)	-4.246** (1.988)	-4.247** (1.959)	-4.162** (1.933)
post vote * services emp sh * EU export sh	0.544* (0.284)	0.534* (0.285)	0.535* (0.286)	0.536* (0.283)	0.523* (0.279)
post vote * tariff exposure		-0.032 (0.060)	-0.031 (0.062)	-0.031 (0.062)	-0.030 (0.062)
post vote * manu emp sh * EU export sh		0.001 (0.002)	0.000 (0.004)	0.000 (0.004)	0.000 (0.004)
export REER			-0.108 (0.233)	-0.108 (0.234)	-0.117 (0.235)
post vote * EU national share				0.004 (0.857)	
post vote * EU8 national share					-0.622 (1.352)
Observations	12,780	12,780	12,780	12,780	12,780
Adjusted R-squared	0.984	0.984	0.984	0.984	0.984
TTWA FE	YES	YES	YES	YES	YES
Month-Year FE	YES	YES	YES	YES	YES

Notes: This table displays the results from the regressions of the log of monthly job postings in each TTWA on the average trade barrier exposure measures at the TTWA level interacted with the post vote dummy variable, with and without controls. All specifications include TTWA and month-year fixed effects, and standard errors (in parentheses) are two-way clustered at the TTWA and month-year level. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

**Table 16: Alternative tariff measures**

Dep variable: log postings	Output weighted		Export weighted		Logged tariffs		Regional export weighted	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
post vote * service barrier exposure		-0.539*** (0.127)		-0.554*** (0.135)		-0.539*** (0.127)		-0.525*** (0.125)
post vote * tariff exposure	9.830 (18.09)	1.122 (21.27)	4.416 (7.898)	-2.999 (8.413)	10.34 (19.11)	1.237 (22.41)	0.000 (0.000)	0.000 (0.000)
export REER		-0.069 (0.084)		-0.082 (0.081)		-0.068 (0.084)		-0.032 (0.075)
post vote * EU national share		-0.248 (0.866)		-0.220 (0.871)		-0.248 (0.866)		-0.277 (0.865)
Observations	12,780	12,780	12,780	12,780	12,780	12,780	12,780	12,780
Adjusted R-squared	0.984	0.984	0.984	0.984	0.984	0.984	0.984	0.984
TTWA FE	YES	YES	YES	YES	YES	YES	YES	YES
Month-Year FE	YES	YES	YES	YES	YES	YES	YES	YES

Notes: This table displays the results from the regressions of the log of monthly job postings in each TTWA on various average trade barrier exposure measures at the TTWA level interacted with the post vote dummy variable, with and without controls. All specifications include TTWA and month-year fixed effects, and standard errors (in parentheses) are two-way clustered at the TTWA and month-year level. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Table 17: Goods non-tariff barriers

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * service barrier exposure	-0.538*** (0.132)	-0.531*** (0.139)	-0.550*** (0.141)	-0.541*** (0.134)	-0.544*** (0.138)
post vote * tariff exposure		-0.017 (0.036)	-0.038 (0.055)	-0.040 (0.054)	-0.042 (0.054)
post vote * goods NTMs		0.069 (0.166)	0.069 (0.165)	0.080 (0.162)	0.104 (0.166)
export REER			-0.135 (0.144)	-0.136 (0.144)	-0.143 (0.143)
post vote * EU national share				-0.333 (0.840)	
post vote * EU8 national share					-1.109 (1.360)
Observations	12,780	12,780	12,780	12,780	12,780
Adjusted R-squared	0.984	0.984	0.984	0.984	0.984
TTWA FE	YES	YES	YES	YES	YES
Month-Year FE	YES	YES	YES	YES	YES

Notes: This table displays the results from the regressions of the log of monthly job postings in each TTWA on the average trade barrier exposure measures at the TTWA level, including non-tariff barriers, interacted with the post vote dummy variable, with and without controls. All specifications include TTWA and month-year fixed effects, and standard errors (in parentheses) are two-way clustered at the TTWA and month-year level.

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Table 18: Specific Tariffs and Quotas

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * service barrier exposure	-0.509*** (0.124)	-0.510*** (0.124)	-0.605*** (0.135)	-0.561*** (0.127)	-0.598*** (0.132)
post vote * tariff exposure	-0.070 (0.079)	-0.070 (0.079)	-0.029 (0.053)	-0.080 (0.079)	-0.027 (0.053)
post vote * ad val tariff exposure	0.126 (0.145)				
post vote * quota exposure		0.125 (0.147)		0.155 (0.165)	
post vote * specific tariff exposure			-1.458 (1.151)	-1.713 (1.143)	
post vote * quota or specific tariff exposure					-2.504 (1.724)
export REER	-0.175 (0.170)	-0.175 (0.171)	-0.130 (0.146)	-0.178 (0.170)	-0.123 (0.145)
post vote * EU national share	-0.305 (0.869)	-0.300 (0.868)	-0.100 (0.852)	-0.112 (0.852)	-0.168 (0.861)
Observations	12,780	12,780	12,780	12,780	12,780
Adjusted R-squared	0.984	0.984	0.984	0.984	0.984
TTWA FE	YES	YES	YES	YES	YES
Month-Year FE	YES	YES	YES	YES	YES

Notes: This table displays the results from the regressions of the log of monthly job postings in each TTWA on the average trade barrier exposure measures at the TTWA level, including barriers due to specific tariffs and quotas, interacted with the post vote dummy variable, with and without controls. All specifications include TTWA and month-year fixed effects, and standard errors (in parentheses) are two-way clustered at the TTWA and month-year level. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Table 19: Import protection and imported inputs

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * service barrier exposure				-0.549*** (0.133)	-0.553*** (0.139)
post vote * intermediate import tariff exposure	-0.024 (0.124)		0.082 (0.216)	-0.019 (0.262)	-0.010 (0.256)
post vote * import protection tariff exposure		-0.008 (0.017)	-0.054 (0.035)	-0.029 (0.041)	-0.027 (0.041)
post vote * export tariff exposure			0.072 (0.062)	0.021 (0.084)	0.017 (0.085)
export REER				-0.140 (0.179)	-0.142 (0.180)
post vote * EU national share				-0.198 (0.849)	
post vote * EU8 national share					-0.733 (1.325)
Observations	12,780	12,780	12,780	12,780	12,780
Adjusted R-squared	0.984	0.984	0.984	0.984	0.984
TTWA FE	YES	YES	YES	YES	YES
Month-Year FE	YES	YES	YES	YES	YES

Notes: This table displays the results from the regressions of the log of monthly job postings in each TTWA on various average trade barrier exposure measures at the TTWA level interacted with the post vote dummy variable, with and without controls. All specifications include TTWA and month-year fixed effects, and standard errors (in parentheses) are two-way clustered at the TTWA and month-year level. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

## **C. Further definitions and robustness check details**

### **C.1 STRI examples**

Some examples of regulations included in the STRI for the Commercial Banking sector under the category ‘restrictions on foreign entry’ are: limiting foreign equity share in local banks, and restricting cross border mergers. In the category of ‘barriers to competition’ some examples are: product level regulations, or having supervisory authorities that are not independent. For the Legal sector under the category ‘restrictions on foreign entry’ some examples are: whether commercial association is prohibited between locally and not locally licensed lawyers, or whether acquisition and use of land and real estate by foreigners is restricted. For the category ‘restrictions on the movement of people’ some examples are: whether foreign professionals are required to take local exams, or whether there are laws or regulations to establish a process for recognising qualifications gained abroad.

### **C.2 Uncertainty indices and discussion**

The referendum result introduced a large overnight change in perceptions about future trade policy arrangements between the UK and EU. However, in addition to this one-off change, the negotiation period from June 2016 to January 2020 was a volatile period of evolving political events that provided signals about what the eventual trading relationship with the EU might be, as discussed in Section 2. This meant that during the negotiation period both expectations about the likelihood of prospective future export barriers and uncertainty around these expectations varied substantially. We therefore also consider how the posting of online job adverts responded on a monthly basis during the negotiation period. We focus primarily on the impact of uncertainty, but we provide further discussion and analysis about the relative roles of uncertainty surrounding expectations and expectations themselves below.

Although uncertainty is challenging to define and measure, we build upon previous efforts in the literature. We first make use of two existing indices that aim to measure the policy uncertainty caused by the Brexit vote. The first is the BUI from the Decision Maker Panel (DMP) survey, constructed by [Bloom et al. \(2019\)](#), and the second is the ‘Brexit Risk’ index constructed by [Hassan et al. \(2020\)](#). While the BUI and Brexit Risk index both focus on the general policy uncertainty caused by Brexit, in this paper we are interested in the trade-policy

specific uncertainty and so we also construct two new measures that aim to capture trade-policy specific uncertainty caused by the Brexit vote. To do so we build upon the methodology in [Baker et al. \(2016\)](#)'s Economic Policy Uncertainty (EPU) Index and [Ahir et al. \(2018\)](#)'s World Trade Uncertainty (WTU) Index and construct these indices using the time-varying prevalence of terms related to trade policy, uncertainty and the Brexit vote in the text of UK newspaper articles and google searches as measured using Google Trends. A more detailed construction of these indices is outlined below.

### **C.2.1 Brexit Uncertainty Index (BUI)**

One concern with using newspaper articles or google searches to measure uncertainty about future trade policy with the EU is that reporters and individuals may have become 'bored' of Brexit and paused reporting on it, or stopped searching for new information, after an initial period, despite the degree of uncertainty about future tariffs remaining the same.

The Decision Makers Panel (DMP) is a panel survey of 8,000 UK firms, with around 3,000 responding in any given month.<sup>45</sup> The BUI is constructed from the DMP and is defined as the share of firms surveyed in a given month that rate Brexit as one of the three highest drivers of uncertainty for their business. More information can be found in [Bloom et al. \(2019\)](#). The BUI is a monthly index commencing from September 2016.

### **C.2.2 Brexit Risk Index**

We also make use of the Brexit Risk index constructed by [Hassan et al. \(2020\)](#). This index identifies the exposure of firms to Brexit-related political risk by measuring the prevalence of the use of 'risk' or 'uncertainty' synonyms near the term "Brexit" in the transcripts of firms' quarterly earnings conference calls with financial analysts. We take the mean of the firm level scores constructed in [Hassan et al. \(2020\)](#) for UK headquartered firms.<sup>46</sup> The Brexit Risk index is a quarterly measure with most recent data reaching up until Q1 2019.

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<sup>45</sup><https://decisionmakerpanel.co.uk>

<sup>46</sup>More details about this measure can be found in [Hassan et al. \(2020\)](#) or on the authors' data website [firmlevelrisk.com](http://firmlevelrisk.com)

### C.2.3 Newspaper coverage index

We begin by combining the list of trade policy uncertainty related terms from the EPU and the WTU, which include words such as ‘trade policy’ or ‘World Trade Organization’. We then remove all terms that would not be related to the trade uncertainty caused specifically by the Brexit referendum (for example, ‘NAFTA’ or ‘Doha round’). This leaves us with a condensed list of 6 trade related terms. Given our additional focus on services trade, we also include two key services-restriction related words: ‘passporting’ and ‘services agreement’. We then follow the WTU Index and search for articles that mention any of these terms with the words ‘uncertain’, ‘uncertainty’ or ‘uncertainties’. While the EPU and WTU indices focus on general trade policy uncertainty, in this paper we aim to isolate the trade policy uncertainty caused by the Brexit referendum. We therefore add an additional requirement for these terms to appear with the words ‘Brexit’, ‘no deal’, ‘leave EU’ or ‘EU’.

Table 20 summarises these terms. We took a monthly count of any article including a term from Category A, a term from Category B, and a term from Category C. We search among the top 10 most popular UK newspapers by circulation.<sup>47</sup> Our data comes from Factiva, a news aggregator, and covers the period 2015-2019.

Table 20: Uncertainty measure included terms

Category 1	Category 2	Category 3
brexit	uncertainty	trade
no deal	uncertain	tariffs
leave EU	uncertainties	passporting
EU		wto
		world trade organisation
		trade policy
		trade agreement
		services agreement

Notes: This table displays the terms used in the uncertainty measures. We counted any article including a term from Category 1, a term from Category 2 and a term from Category 3.

<sup>47</sup>These are The Daily Mail, The Sun, The Mirror, The Express, The Times, The Telegraph, The Guardian, The Independent, The Daily Express and The Metro.

## C.2.4 Google search index

Our second approach is to use an index of Google searches. Google searches offer an alternative way to gauge the degree of public engagement surrounding Brexit and future trade policy, through directly observing what people are searching for. Google Trends provides public information on the Google searches conducted within a given region over time.<sup>48</sup> We use searches for the same terms as for the newspaper measure, but exclude the uncertainty-related terms.<sup>49</sup>

## C.2.5 Comparing uncertainty measures

Figure 17 compares trajectories of these four measures during the negotiation period. This is the period on which our analysis of the impact of uncertainty is focused. All measures are normalised to 1 for September 2016 so that the three indices considered are comparable for the period when the BUI is available. All follow similar trends, with uncertainty flat or declining from September 2016 until mid 2018, then rising steeply and peaking around late 2018 or early 2019, then dropping again. The BUI has a lower variance and fluctuates less than the other measures, while the Brexit Risk index falls more than the other measures after September 2016. Newspaper coverage peaked in November 2018, the month when the UK and EU finally agreed on the text of the draft withdrawal agreement and a summit was held where all EU27 nations endorsed the Brexit deal, while the Google search index peaked two months after this in January 2019. Both newspaper coverage and Google searches then remained high until March 2019, when the government put in a request to extend Article 50.

## C.2.6 Uncertainty or expectations?

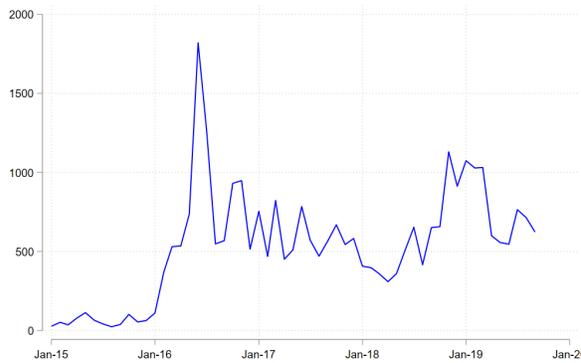
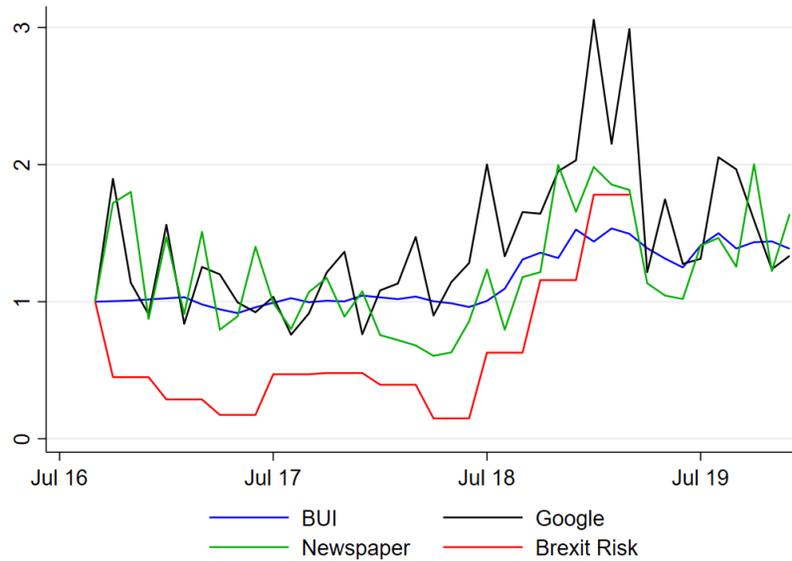
We might expect that both uncertainty around future UK-EU trading relations and negative expectations about future UK-EU trading relations would have affected online job postings. Our time-varying indices were designed to measure uncertainty, the *second moment*, or variance, of expectations about Brexit. It is also interesting to consider how the *first moment* of expectations themselves changed during the negotiation period.

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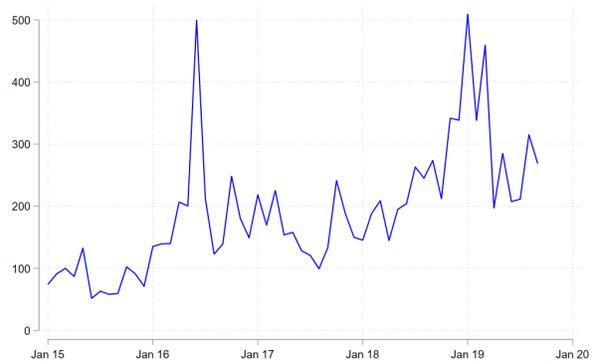
<sup>48</sup><https://trends.google.com/trends>, our index is a self-referential, relative measure of searches rather than an absolute number.

<sup>49</sup>We assume that when individuals are uncertain about future trade arrangements they will not search for the word 'uncertain', whereas newspapers would report on uncertainty using these words.

Figure 17: Brexit trade policy uncertainty measures



(a) Newspaper coverage

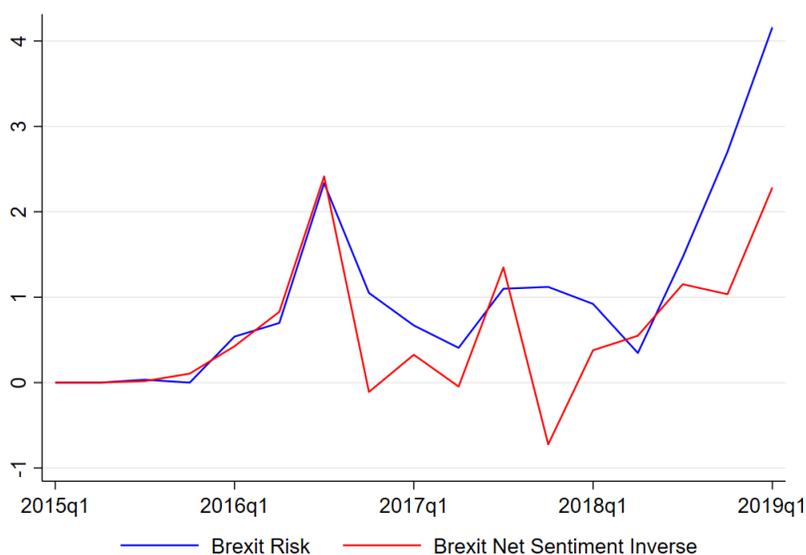


(b) Google searches

Notes: For illustrative purposes the measures are normalised to 1 on September 2016, non-normalised versions are used in regressions. The BUI originates from the UK DMP Survey. The Brexit Risk index originates from UK firms' quarterly earnings calls. The newspaper index is constructed using newspaper articles including key terms relating to Brexit, uncertainty and trade policy. These measures reflect the total number of articles in the UK's top 10 newspapers including the relevant searches terms in each month. The Google index shows the uncertainty measure constructed using Google searches for key terms relating to Brexit and trade policy, it reflects search intensity for the relevant search terms in each month.

Expectations about future trade policy outcomes are somewhat harder to measure with existing data sources than uncertainty. However, one proxy measure for firms' general expectations about Brexit is the 'Brexit Sentiment' index also constructed by Hassan et al. (2020).<sup>50</sup> This index is constructed analogously to the Brexit Risk index, but instead of measuring the prevalence of uncertainty and risk synonyms, it instead measures the direction of the sentiment of the text discussing Brexit.

Figure 18: Brexit Risk and Sentiment Indices



Notes: This figure shows the mean Brexit Risk and Brexit Sentiment indices constructed by Hassan et al. (2020). The risk index reflects greater discussion of risk and uncertainty synonyms when discussing Brexit. The inverse of the sentiment index reflects more negative sentiment when discussing Brexit.

Figure 18 displays the average of this index for UK headquartered firms, compared with the Brexit Risk index.<sup>51</sup> These two indices are quite highly correlated, demonstrating that when uncertainty about Brexit was high, discussion about the outcomes of Brexit also tended to be more negative in sentiment. This is perhaps intuitive: uncertainty seems to have increased when it looked like Brexit was going to involve the greatest divergence in UK-EU relations relative to before the vote. Greater divergence in UK-EU relations was also associated with worse trade policy outcomes.

<sup>50</sup>An alternative was to follow the approach in papers such as that by Graziano et al. (2018) and use prediction markets to gauge expectations. However, betting markets tend to release contracts on narrowly defined questions over a limited period of time. Since we aim to measure expectations about export barriers over the entire pre-and post-Brexit period, this type of measure was not feasible. Public polling was an additional option, but few polls asked the same question over time.

<sup>51</sup>We take the inverse of the sentiment index such that positive values reflect more negative sentiment about Brexit.

In Table 21, we present additional results from specifications including the sentiment index entering alone or together with the Brexit risk index. The estimated coefficients on the interaction between the sentiment index and services barrier exposure are negative and statistically significant at the ten percent level, suggesting that postings also declined when sentiment around Brexit was more negative. Interestingly, including both interaction terms with both sentiment and risk index in the same specification yields coefficients with limited significance for both, but the risk index remains slightly more significant. These indices do not capture trade-specific sentiments, so we are unable to speak to how trade policy expectations affected job postings. However, we conclude that it is difficult to disentangle the first and second moment of expectations as both seem to be highly correlated.

Table 21: Brexit Risk and Sentiment Indices Compared

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)	(6)
Brexit risk*service barrier exposure	-0.141*** (0.0498)	-0.172*** (0.0508)			-0.113 (0.0697)	-0.146* (0.0716)
Brexit risk *tariff exposure	0.00548 (0.00954)	0.0108 (0.00975)			0.0166 (0.0123)	0.0222* (0.0129)
Brexit risk*EU national share	-1.585*** (0.281)				-1.647*** (0.366)	
Brexit risk*EU8 national share		-2.394*** (0.414)				-2.454*** (0.560)
Brexit sentiment*service barrier exposure			-0.156* (0.0872)	-0.183* (0.0956)	-0.0499 (0.110)	-0.0476 (0.118)
Brexit sentiment *tariff exposure			-0.00456 (0.00959)	0.000298 (0.00862)	-0.0199 (0.0129)	-0.0203* (0.0117)
Brexit sentiment*EU national share			-1.424** (0.538)		0.109 (0.514)	
Brexit sentiment*EU8 national share				-2.180** (0.860)		0.106 (0.847)
export REER	0.124 (0.404)	0.148 (0.411)	0.175 (0.419)	0.191 (0.420)	0.149 (0.393)	0.174 (0.399)
Observations	6,603	6,603	6,603	6,603	6,603	6,603
Adjusted R-squared	0.988	0.988	0.988	0.988	0.988	0.988
YES	YES	YES	YES	YES	YES	YES
Month-Year FE	YES	YES	YES	YES	YES	YES

Notes: This table displays the results from the regressions of the log of monthly job postings in each TTWA on the average trade barrier exposure measures at the TTWA level interacted with the Brexit Risk and Brexit Sentiment Indices from Hassan et al. (2020). All specifications include TTWA and month-year fixed effects, and standard errors (in parentheses) are two-way clustered at the TTWA and month-year level. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

### C.3 UK import tariffs

Although most of the discussion around tariffs centered around the potential impact of EU tariffs on UK exports, there was also some uncertainty concerning possible UK tariffs on imports from the EU under a no deal scenario. We therefore further evaluate whether the threat of these tariffs had any impact on the posting of job adverts. We consider two potential channels.

#### C.3.1 Exposure to reduced competition through import tariffs

One channel through which import tariffs could affect UK businesses is by increasing the price of imports that compete with UK products, hence rendering UK firms more competitive in the domestic market. We can create a similar exposure measure as used for exports but with weightings based on UK imports rather than exports. Although it was unclear during the negotiation period what the UK tariff schedule would look like under a no deal scenario, we use the EU MFN tariffs as a plausible default option for the analysis. This is reinforced by the fact that the MFN principle ensures that the UK could not unilaterally lower its tariffs with respect to the EU without doing the same thing for imports from third countries, unless part of a comprehensive free trade agreement (not present under ‘no deal’ by definition). The potential sectoral future tariff protection exposure is:

$$\text{imp protection}_{j^{manu},2014} = \frac{\text{Imports}_{j^{manu},2014}}{L_{j^{manu},2015}} \times \text{avg MFN tariff}_{j^{manu},2014}^{(Imp)} \quad (13)$$

where  $\text{avg MFN tariff}_{j^{manu},2014}^{(Imp)}$  is the import-weighted average EU MFN ad valorem tariff across all products mapped to sector  $j^{manu}$ ,  $L_{j^{manu},2015}$  is the national employment in sector  $j^{manu}$  (4-digit ISIC), and  $\text{Imports}_{j^{manu},2014}$  is UK imports from the EU in 2014. The TTWA level exposure is then:

$$\text{imp protection}_r = \sum_{j^{manu} \in r} \text{empl share}_{j^{manu},r,2015} \times \text{imp protection}_{j^{manu},2014} \quad (14)$$

where  $\text{empl share}_{j^{manu},r,2015}$  is industry  $j^{manu}$ 's share of TTWA  $r$  employment.

### C.3.2 Exposure to increased cost of imported inputs

Alongside potential protection of UK industries, tariffs may have the additional negative impact of increasing the cost of inputs. If industries typically import inputs which are either not produced by UK firms, or are produced at a higher price, then the imposition of tariffs on these products would increase costs and potentially reduce production. We calculate this exposure by taking the import protection measure from above and, using UK input-output tables, weighting it by the share this ‘input’ industry makes up in all of the ‘output’ industry’s imported inputs.<sup>52</sup> Specifically, the measure is calculated as follows:

$$\text{intinputs threat}_{k,2014} = \frac{1}{L_k} \sum_{j^{manu}} S_{k,j^{manu}} \sum_{p \in j^{manu}} \text{Imports}_p \times \text{MFN tariff}_{p,2014} \quad (15)$$

$$\text{intinputs threat}_r = \sum_{k \in r} \text{empl share}_{rk,2015} \times \text{intinputs threat}_{k,2014} \quad (16)$$

where  $k$  is the output sector,  $j^{manu}$  is the input sector (both at the 2-digit SIC level), and  $S_{k,j^{manu}}$  is the imported inputs from  $j^{manu}$  as a share of total imported inputs by  $k$ .

## D. Comparison of BGT data with other sources

Online job adverts encompass only a subset of all vacancies because a) not all vacancies will be advertised publicly and b) not all publicly advertised vacancies will be advertised online. We would hence expect the BGT job advert data to differ from the total number of actual vacancies in sectors, regions and job types where employers are less likely to publicly advertise vacancies or to advertise them online.

In the UK, it is not a legal requirement to publicly advertise a job vacancy. However, there is an obligation for employers not to discriminate against employees or potential employees and an employer could face legal action if it is believed that a job has not been fairly advertised. Consequently, it is very common for firms to have company policies that require all open positions to be publicly advertised.

We would generally expect that BGT would cover a high proportion of all vacancies, par-

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<sup>52</sup>UK input-output tables: [www.ons.gov.uk/economy/nationalaccounts/supplyandusetables/datasets/ukinputoutputanalyticaltables-detailed](http://www.ons.gov.uk/economy/nationalaccounts/supplyandusetables/datasets/ukinputoutputanalyticaltables-detailed)

ticularly for large firms. However, if one job advert is posted online for a number of openings at once, for example in the case of graduate schemes, then we would expect that BGT would underestimate the true number of vacancies.

In this Appendix, we evaluate the relationship between BGT online job adverts and the estimated number of vacancies from the UK Vacancy Survey as well as measures of job flows as captured by the ONS.

## 1. UK Vacancy Survey (UKVS)

The UKVS is a statutory, monthly survey of businesses conducted by the ONS. The survey asks a single question: how many job vacancies did a business have in total (on a specified date) for which they were actively seeking recruits from outside their organisation? Results from the survey cover all sectors of the UK economy and all industries, with the exception of employment agencies and agriculture, forestry and fishing.<sup>53</sup>

The total sample is approximately 6,000 businesses per month, with approximately 1,300 large businesses included every month and the remaining 4,700 consisting of smaller enterprises randomly sampled on a quarterly basis. The ONS then constructs total estimates for the UK by weighting the data using employment estimates. For non-responding firms a link factor is calculated and applied to previous returns. The original construction for a never-responding business is calculated from a ratio (calculated from other respondent values in the same sampling strata) being applied to the register employment. For subsequent periods, imputed values are then based on movements in similar-sized businesses. They then provide quarterly seasonally adjusted estimates of the monthly average number of vacancies for the UK economy.<sup>54</sup>

The UKVS is limited to national quarterly figures and doesn't provide a breakdown by occupations, hence it would be not be a suitable data source for our analysis.

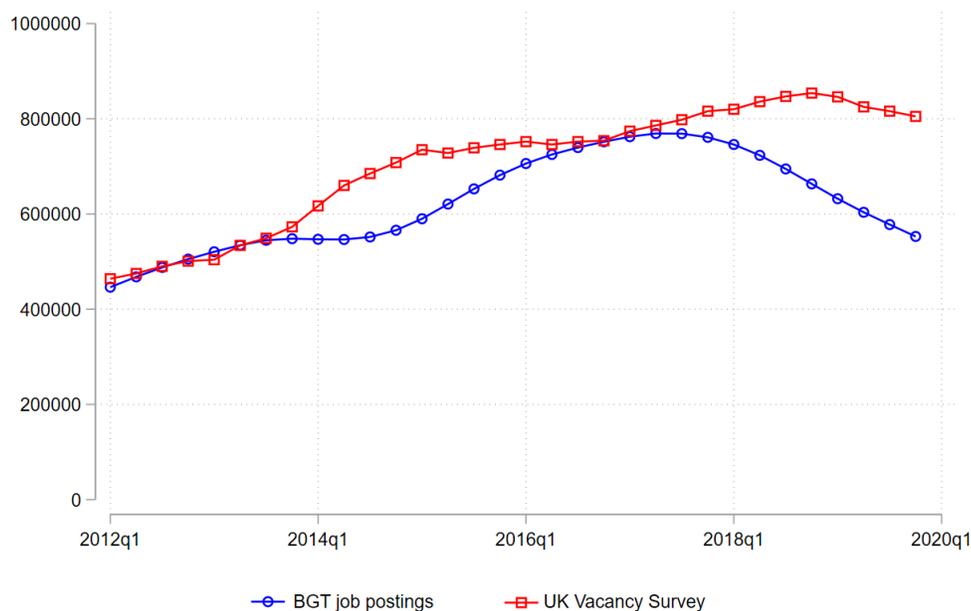
To compare figures from the two sources, we deseasonalise the BGT data and take quarterly averages of the total sum of all postings. Figure 19 compares the time series of BGT with the UKVS over the period of 2012-2019. Over this period, BGT covers on average 86 percent of the total reported in the UKVS. The monthly average number of postings in the BGT data

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<sup>53</sup>A summary can be found here: <https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/methodologies/vacancysurveyqmi>

<sup>54</sup>Results are seasonally adjusted in X-12 ARIMA using a multiplicative model.

Figure 19: Average monthly vacancies: BGT and UK Vacancy Survey



*Notes:* This figure compares the seasonally adjusted average monthly number of job postings from BGT with the UK Vacancy Survey. We deseasonalise the BGT data using the Hodrick–Prescott high-pass filter.

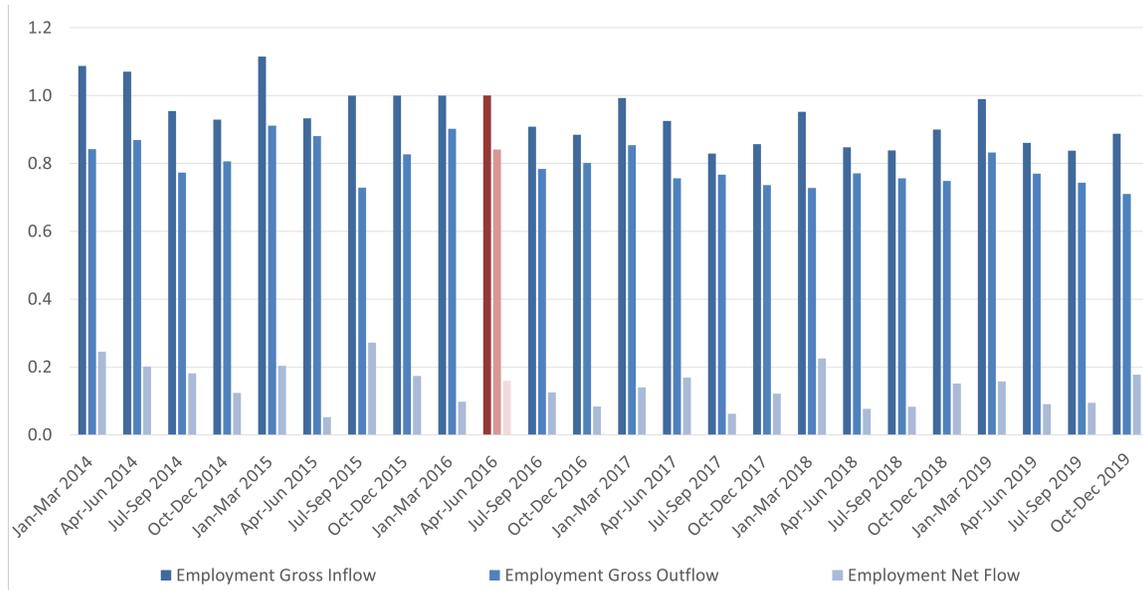
is very similar to the monthly average number of vacancies reported in the UKVS during two period: 2012 & 2013 and 2016, but the two series diverge during 2014, 2015 and after 2016. This divergence could reflect the fact that the UKVS relies on imputed values, or that firms inaccurately report their number of openings in specific time periods, for example due to uncertainty, or that there has been a structural change in the average number of jobs advertised in one online posting during these time periods. Methods of imputation may not be responsive to labour market trends in the way that directly observed, scraped data would be. We hence might expect the UKVS to over-estimate vacancies in periods of uncertainty on in downturns; this may explain the divergence after the Brexit referendum.

### 3. ONS Labour force survey flows estimates

Job adverts provide an insight into labour demand from the labour inflows perspective, but do not speak to the other side of the coin: firm-employee separations. The results of the ONS Labour Force Survey contain some estimates for job flows, which, although not available at high frequency or at the local labour market level, can provide some useful insights. Figure 20 displays the inflows and outflows from the pool of UK employment over time, as

well as the net inflow. All figures in this subsection are displayed as the percentage of the two previous periods of total employment, as well as being normalised relative to the relevant quarter in the year preceding the referendum in June 2016. This graph shows that gross inflows and gross outflows show a very slight declining trend over the time frame, implying a slight decrease in the dynamism of the workforce, but displays no major change.

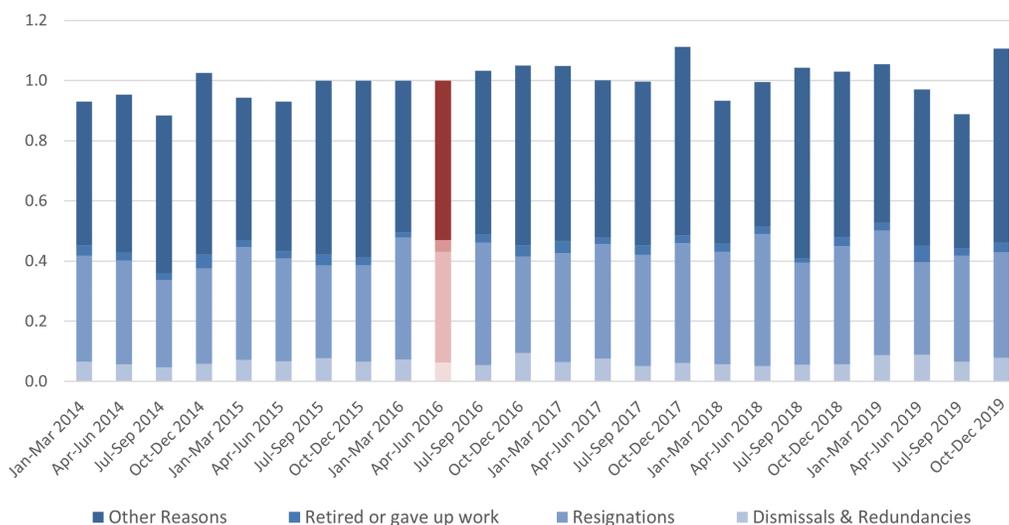
**Figure 20:** Gross and net employment inflows and outflows as a percentage of employment, normalised relative to pre-referendum period



*Notes:* This figure is displayed as the percentage of the two previous periods of total employment, as well as being normalised relative to the relevant quarter in the year preceding the referendum in June 2016

Figure 21 displays job-to-job moves displayed by reason for leaving previous employment. The category ‘other reasons’ includes those whose temporary job came to an end or who left their previous job for health reasons, education or training purposes or some other reason (as well as those who did not provide a reason). Overall, job-to-job moves marginally increased over the period. The largest increase occurred in the ‘resignations’ category, hence implying that workers were not responding to Brexit uncertainty by increasingly holding on to existing jobs, but in fact the opposite. There was also a very small increase in ‘dismissals and redundancies’ which shows that firms may also be adjusting along this margin, however, the effect is much smaller than the decrease in postings (see Figure 1).

**Figure 21: Job-to-job moves by reason for move as a percentage of employment, normalised to pre-referendum period**



*Notes:* This figure is displayed as the percentage of the two previous periods of total employment, as well as being normalised relative to the relevant quarter in the year preceding the referendum in June 2016

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