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 substantial 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

1. Introduction

Decades of research in international economics have been devoted to understanding the consequences of trade barriers. Although by now the effects of barriers on trade in goods are well understood, 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.[1] 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 some of the largest changes in services trade policy in recent history, its outcome was largely unexpected and introduced plausibly exogenous variation in the extent of exposure to future barriers. Leaving the EU Single Market meant the UK becoming a third party to other European Economic Area (EEA) countries and trade in services reverting to the terms set by individual member states under the General Agreement on Trade in Services (GATS).[2] This shift in trade policy varied across industries and export destinations, depending on the regulatory 'gap' between services trade restrictions applying to the EEA members and those applying to third countries under the specific GATS terms. As services accounted for 81% of UK economic output and 46 percent of exports in 2018 (ONS, 2019), this

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[1]Services account for the vast majority of value added and employment in advanced economies. Services trade is on the rise, growing faster than trade in goods. Barriers to services trade are higher and more complex than barriers to trade in goods, which calls for rigorous research to identify relevant services trade restrictions and investigate their effects on economic outcomes. And yet the effect of services trade policy remains largely understudied.

[2]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.

anticipated shock to services trade policy would have 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 full referendum and negotiation period between January 2015 and December 2019.[3] We use a high frequency dataset, capturing the near universe of online job adverts in the UK at a granular geographic level, 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 to disaggregate the impacts by occupation and skill type. The local labour market perspective also allows us to examine potential spillover effects across localities.[4]

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, accounting for 88% of services exports in 2015. 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

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[3]The UK formally left the EU at the end of January 2020, just at the start of the COVID-19 pandemic. This meant that it became difficult to disentangle the realized impacts of Brexit from the effects of the pandemic in 2020 and 2021. Studying the referendum and negotiation period hence provides one of the best opportunities to cleanly evaluate the relationship between expectations over trade barriers and firms' responses. With the future trading relationship between the UK and EU also decided during the negotiation period, markets had adjusted their expectations well-ahead of the UK formally leaving the EU.

[4]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.

export partners, with the gap determined by GATS terms that were generally set during the WTO's Uruguay Round in 1995.[5]

The Brexit referendum 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 (like any other third-party country) would have faced the EU's existing Most Favoured Nation (MFN) tariff schedule 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.[6] We also consider the impact of barriers to UK imports, although we primarily focus on export barriers for two reasons. The first is that, unlike export barriers, the UK maintained the option to lower import barriers at any time under any Brexit scenario. The second is that throughout the negotiation period the UK had frequently announced plans to unilaterally liberalize trade policy for imports, meaning that the threat of barriers to imports was low.[7]

Immigration was a key theme of the Brexit campaign and a central issue during the negotiation period. The referendum result introduced the prospect of ending free movement of people between the UK and the EU, which would limit the future ability of UK firms to employ EU nationals. Our analysis, therefore, takes into account a differential exposure to this shock of TTWA with different shares of employment of EU nationals and Eastern European nationals in the pre-referendum period. Finally, we take into account the differential exposure of TTWAs

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[5]The EU external policy on trade in services differs from the external EU policy on trade in goods. While there is only one external EU tariff when it comes to goods trade, EU countries differ in terms of the GATS commitments they have made. In addition, while integration within the EEA has led to considerable regulatory harmonisation in many services industries for trade within the EEA, there still remains significant variation in the barriers imposed by EEA countries on trade within the EEA in certain services industries.

[6]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

[7]For example, Liam Fox, the UK's Secretary of State for International Trade at the time, mentioned proposals to unilaterally set zero tariffs on imports on July 5th 2018 and February 5th 2019.

to exchange rate movements depending on their reliance on exports.

Our analysis follows a difference-in-differences approach, comparing the posting of online job adverts in localities highly exposed to the Brexit shock to those in less exposed localities in the post-referendum versus the pre-referendum period. We demonstrate that this strategy is warranted through several checks for differential growth in online job postings in more and less barrier-exposed TTWAs in the period before the vote, finding no evidence of such 'pre-trends'. This is consistent with the view that the result of the Brexit referendum was largely unexpected.[8]

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% 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 half a 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, this is equivalent on average to 11.8% loss in monthly 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

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[8]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% in the months leading up to the referendum (Graziano et al., 2018).

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.

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 tariffs there are two exceptions. First, we find a negative effect on job postings for the occupation category corresponding to plant and machine operators. This occupational category captures manufacturing workers, the exact group for whom barriers to trade in goods would have the largest impact. And the estimated effect is substantial: a one standard deviation increase in exposure to tariffs corresponds to a -3.6% decline in job postings for this group. Second, we find evidence suggesting that the threat of tariffs matters when we augment the analysis to take into account a larger geographic area and study the effects of tariff exposure going beyond own TTWA. We find that higher exposure of nearby TTWAs (those within a 100km radius, a 200km radius or TTWAs weighted by inverse distance or inverse distance squared) is associated with fewer job postings. A one standard deviation increase in (inverse distance) weighted exposure of neighbouring TTWAs translates into 7.8% fewer jobs posting. This result is consistent with the prevalence of production networks in manufacturing. We do not find evidence of such spillovers for professional services barrier exposure, which is in line with services production being less reliant on supply networks.

The contrast between the findings for services and goods barriers is most likely due to the

much larger magnitude of the expected barriers to services trade, as compared to goods trade. For instance, according to the estimates of Benz and Jaax (2022), the difference between the ad valorem equivalents of barriers in financial services within the EEA versus barriers among WTO members (not trading on preferential terms) was on average 183%. The corresponding figure for the insurance sector was 177%. This contrasts sharply with the EU's external tariff of 3.3% in 2016.[9] Moreover, already in July 2018, the White Paper published by the UK government spelled out its intentions to negotiate a free trade agreement for goods, while accepting barriers to services trade that would be an inevitable consequence of the intended regulatory divergence ('freedom to chart its own path') mentioned in the paper. While the White Paper has not eliminated uncertainty about the outcome of negotiations with the EU, it clearly indicated the desired direction of these negotiations, sending a clear positive signal to the manufacturing industry and a clear negative signal to services sectors. Finally, it is worth keeping in mind the small share of total UK employment being in manufacturing 8% in 2015, as compared to 43% share of professional services on which we focus in this study.

Our results are robust to various specifications including pre-vote placebo tests, excluding London from the analysis, measuring exposure to barriers in various different ways and alternative ways of clustering of standard errors. The robustness tests, suggested by Borusyak et al. (2022a), do not reject the suitability of our approach. Moreover, we do not find any evidence of effects of the threat of goods non-tariff barriers or import tariffs on job postings.

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% of UK GDP and 11.7% 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

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[9]As we discuss later in the paper, barriers to goods trade are much lower than barriers to services trade even if one takes into account ad valorem equivalents of non-tariff barriers in goods trade.

as extremely damaging to many of the core business operations of financial firms based in the UK.[10] 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.

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.

Our research contributes to several strands of the existing literature. First, it 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 and employment in manufacturing (Arnold et al., 2011, 2016; Barone and

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[10]For more information on passporting see https://www.bankofengland.co.uk/prudential-regulation/authorisations/passporting

Cingano, 2011; Beverelli et al., 2017; Breinlich et al., 2018; Fiorini et al., 2018) to the implications of services offshoring (Liu and Trefler, 2019; Crinò, 2010; Eppinger, 2019; Amiti and Wei, 2005) and the tradability of services (Jensen and Kletzer, 2005; Gervais and Jensen, 2019).[11] 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.

Second, we add new evidence to the literature 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 (see, for example, Autor et al. (2014), Pierce and Schott (2016) and 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.

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

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[11]The impact of services trade on the employment in the broad population of Italian firms has been studied by Bamieh et al. (2021) using a shift-share instrumental variable approach.

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. (2018b); and Handley and Limão (2017)).[12] 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 Brexit, which includes studies by Crowley et al. (2018a), Graziano et al. (2018), Costa et al. (2019), Bloom et al. (2019) and Breinlich et al. (2019) as well as an early literature review by Dhingra and Sampson (2022). We differ from these studies in two dimensions. First, we focus barriers to services exports rather than just barriers to trade in goods or general uncertainty about future trade policy. Second, we explore the 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, summarises the data sources used and con-

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[12]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).

struction of our exposure measures, Section 4 presents the baseline results, Section 5 presents additional results and mechanisms, Section 6 presents robustness checks and Section 7 concludes.

2.   Background on the Brexit Referendum

The UK electorate chose to leave the EU on the 23rd June 2016 with 51.9% voting in favour of leaving the EU and 48.1% 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% for most of the preceding year, and the fact that the pound-dollar exchange rate fell by 8% 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 B1 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 final 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

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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.[13]

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.

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 per-

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[13]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.

ceived 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.

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.[14]

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 EU import tariffs. The UK would then be treated as any other third-party country, with the application of the EU's existing 'most-favoured nation' (MFN) 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.

2.2 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 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

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[14]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.

'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.[15]

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.[16]

3.   Empirical strategy, data and variable definitions

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[15]Although at the time of writing this paper more than two years have 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.

[16]For reference, the situation as of the early 2024 was as follows. The Trade and Cooperation Agreement (TCA) was reached between the UK and the EU on 24th December 2020. It was applied provisionally as of 1 January 2021 and entered into force on 1 May 2021. The agreement contains some general rules on trade in services, but stops short of equivalence for financial services and represents a major loss of access for UK firms to the EU market. A further memorandum for cooperation on financial services was signed on 27 June 2023, but it has not provided additional access to EU markets.

3.1 Baseline specification

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:

$$log(postings_{rt}) = \beta_0 + \beta_1 trade\_barrier\_threat_r \times postvote_t + \mathbf{X}'_{rt}\boldsymbol{\beta}_2 + \gamma_t + \gamma_r + \epsilon_{rt} \qquad (1)$$

where $postings_{rt}$ are the total number of online job adverts posted in month-year t and TTWA r, $postvote_t$ is a dummy variable for the time period after the referendum (July 2016 onwards inclusive), $trade\_barrier\_threat_r$ is a measure of the exposure of TTWA r to future trade barriers between the UK and the EU, and X_{rt} includes exchange rate and immigration controls.

The primary trade barriers threats considered include exposure to potential barriers on UK professional services exports to the EU, and exposure to potential tariffs on UK goods exports to the EU. Controls include the share of employment of EU nationals and Eastern European nationals in the pre-referendum period by TTWA, and TTWA exposure to exchange rate changes.

We do not include the post-vote variable on its own, as our specification includes month-year fixed effects. 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 use two-way clustering of standard errors at TTWA-level and time period (i.e. month-year)-level to permit valid inference if errors are auto-correlated within TTWA as well as within time periods across TTWAs (Cameron et al. (2011)).[17] We estimate this specification on the full sample as well as different skill and occupational groups, as defined in Section 3.3.

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[17]We will test the robustness of our results to alternative clustering.

3.2 Online job adverts

Our main dependent variable is the total number of online job adverts posted in month-year t and TTWA r. 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.[18] 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 the Online Appendix, 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% 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.[19] The postings cover 228 TTWAs across the UK, with 76% 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 B2 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

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[18]Duplicates are recorded as a single posting in the first period in which the posting occurs.

[19]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.
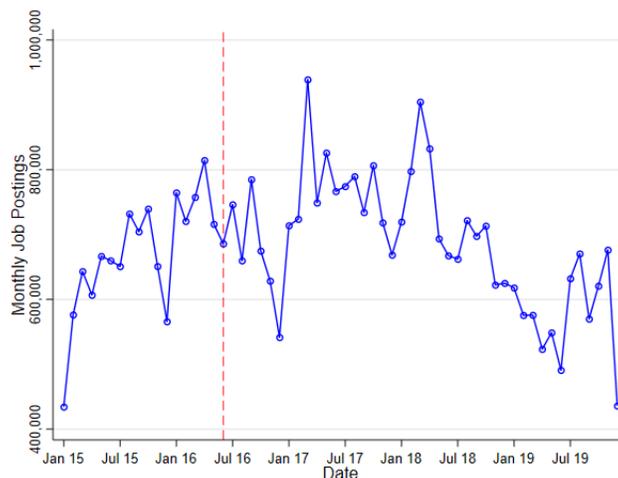
Figure 1: Monthly online job postings in the UK

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

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.

3.3 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 B3 in the Online Appendix.

The ONS classifies the 2-digit sub-major groups of the SOC 2010 into four skill levels.[20] We define the top two levels (3 and 4) as 'high skill' and the bottom two (1 and 2) as 'low skill'.[21]

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[20]'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'. https://www.ons.gov.uk/methodology/classificationsandstandards/standardoccupationalclassificationsoc/soc2010volume1structureanddescriptionsofunitgroups

[21]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'.

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Figure A8 in the Online Appendix 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.

3.4 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% of the area's resident workforce work in the area, at least 75% 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.[22]

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, with the exception of agricultural employment (i.e., SIC codes 0111-0150). BRES collects employment information from businesses across the whole of the Great Britain economy for each site that they operate, surveying approximately 85,000 businesses. In 2015, the BRES data captured 28.5 million employees, or 91% of the total UK labour force as estimated by the ONS.[23]

We take into account all employed individuals, where an employee is defined as anyone

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[22]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/traveltoworkareaanalysisingreatbritain/2016

[23]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.

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.[24,25]

3.5   TTWA exposure to barriers on exports of professional services

Our main independent variable of interest is the interaction between the exposure to potential future barriers on UK professional services exports to the EU and a post Brexit vote indicator. 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' 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 each sector 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

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[24]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. 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.

[25]Across all TTWA in our dataset, the following sectors account for the highest share of employment at the 2-digit SIC 2007 level: SIC 47 - Retail trade, except of motor vehicles and motorcycles (9.9%); SIC 85 - Education (9.2%); and SIC 86 - Human health activities (7.5%).

included in the STRI are included in the Online Appendix.[26]

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.[27]

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.[28] 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 Telecoms.[29]

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

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[26]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.
Miroudot and Pertel (2015) and Benz and Rozensteine (2021) have shown that the level of restrictiveness in the MFN OECD STRI is systematically lower that that implied by the GATS schedules, which suggests countries keeping restrictions below their GATS commitments and thus not using all the policy space available to them.

[27]https://www.oecd-ilibrary.org/trade/intra-eea-stri-database_2aac6d21-en.

[28]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.

[29]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.
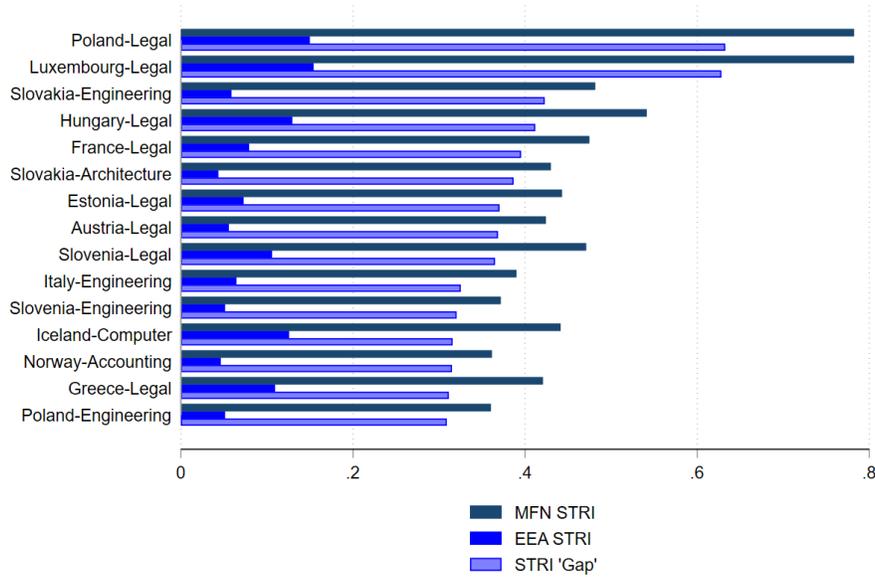
Figure 2: Country-sector pairs with highest STRI 'gap'

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.

the ONS.[30] 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 in 2015. Thus the sector specific threat of export barriers is defined as follows:

$$services\_barrier\_exposure_{j^{serv}} = \frac{Exports_{j^{serv},2015}}{L_{j^{serv},2015} \times avgSTRIgap_{j^{serv},2014}} \tag{2}$$

where the $avgSTRIgap_{j^{serv},2014}$ 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 national exports to the EEA in sector j^{serv} in 2015 as measured by the ONS and $L_{j^{serv},2015}$ is national employment in sector j^{serv} in 2015 as measured using the BRES employment data. We express

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[30]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 B4 of the Online Appendix.

exports in per worker terms following the approach of Autor et al. (2013) and Blanchard et al. (2019). Doing so 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 2 displays the top 15 country-sector pairs ranked by the difference between the MFN and intra-EEA STRI. Legal services appear most frequently 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.

Figure A1 in the Online Appendix displays the sector-specific weighted barrier measures, as defined in equation (2). Financial services top the ranking, followed by Insurance, Information services, Legal services, Computer services, Telecoms, Accounting, Engineering and Architecture.[31]

Exposure to export services barriers at the local labour market level is defined as the average value of exposure across all services industries, weighted by each industry's share in the TTWA's employment:

$$services\_barrier\_exposure_r = \sum_{j^{serv} \in r} emplshare_{j^{serv}r,2015} \times services\_barrier\_exposure_{j^{serv}} \quad (3)$$

where $emplshare_{serv_r,2015}$ is employment in sector j^{serv} in 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

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[31] The ratios of exports to employment by industry are also displayed in Figure A2 in the Online Appendix.
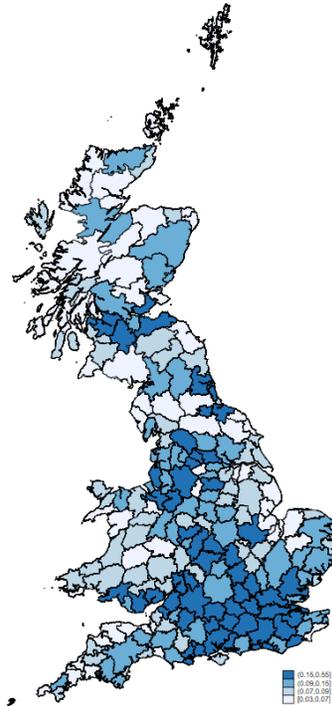
Figure 3: Exposure by Travel to Work Area: Services barrier exposure

Notes: This map displays the baseline employment-weighted services barrier exposure for each TTWA. Darker colours represent more exposed areas. *Sources*: Services barriers from OECD STRI, employment shares from UK ONS BRES, trade data from UK ONS.

Scotland. Figure A3 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.[32]

3.6 TTWA exposure to tariffs

Another important variable in our analysis is the TTWA exposure to potential future barriers on goods exports to the EU, which in our specification will be interacted with a post-referendum indicator. 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.

We use tariff data from the World Integrated Trade Solution (WITS) database (TRAINS), se-

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[32]In the most exposed TTWA, Edinburgh, professional services make up 15% of total employment with monetary intermediation being the most important sub-sector. Whereas the least exposed TTWA, Girvan, has only 1.2% in professional services mostly split between monetary intermediation and activities of holding companies. Table B6 in the Online Appendix provides a more detailed breakdown on the professional services employment shares for these two TTWAs.

lecting 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 (from COMTRADE). 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.[33] As was the case with services exposure, we multiply the average weighted MNF tariff by the value of UK exports to the EU per employee in the sector.[34] More specifically, our industry-level measure of tariff exposure is defined as follows:

$$tariff\_exposure_{j^{manu},2014} = \frac{Exports_{j^{manu},2014}}{L_{j^{manu},2015}} \times avgMFNtariff_{j^{manu},2014} \qquad (4)$$

where $avgMFNtariff_{j^{manu},2014}$ is the UK export-weighted average EU MFN ad valorem tariff across all HS6 products mapped to manufacturing sector j^{manu}, $Exports_{j^{manu},2014}$ are exports 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:

$$tariff\_exposure_r = \sum_{j^{manu} \in r} emplshare_{j^{manu}r,2015} \times tariff\_exposure_{j^{manu}} \qquad (5)$$

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[33]unstats.un.org/unsd/classifications/econ/. We use CPC Ver 2.1 as an intermediate nomenclature between HS 2012 and ISIC Rev. 4.

[34]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.
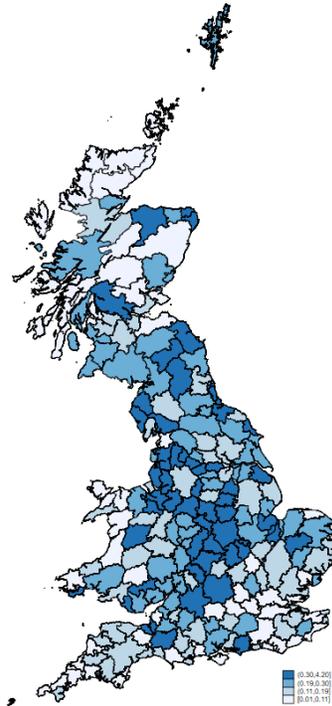
Figure 4: Exposure by Travel to Work Area: Tariff barriers

Notes: This map displays the baseline employment-weighted tariff exposure for each TTWA. Darker colours represent more exposed areas. *Sources*: Tariffs from WITS TRAINS, employment shares from UK ONS BRES, trade data from COMTRADE.

where $emplshare_{j^{manu}r,2015}$ 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 A6 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 import 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.[35] We

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[35]For example, see https://www.ft.com/content/d97854c2-2941-11e9-a5ab-ff8ef2b976c7

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.

3.7 Control variables

During the period considered, job adverts may have also been affected by other factors arising from the result of the Brexit referendum which can be controlled for as presented in the specification described in Section 3.1. These include: expected changes to the immigration rules applying to EU nationals and the sharp depreciation of the pound sterling after the referendum.

3.7.1 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.[36]

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 social and labour market variables at a local area level. The APS is not a stand-alone survey, but com-

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[36]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.

bines 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:

$$EU\_national\_share_{r,NUTS1} = \sum_{k \in r} emplsh_{kr,2015} \times \frac{EUworkers_{k,NUTS1}}{L_{k,NUTS1}} \qquad (6)$$

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 A7 of the Online Appendix. In the estimation, these measures are interacted with the post vote indicator. Correlations between the various exposure measures are presented in Table B5 in the Online Appendix.

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.

3.7.2 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:[37]

$$E_{rt}^X \equiv \sum_j emplsh_{jr,2015} \times \frac{Exports_{j,2014}}{L_{j,2015} \times REER_t} \tag{7}$$

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 $Exports_{j,2014}$ by the equivalent sectoral sum of imported inputs. The latter measure is used in robustness checks.

4. Estimation Results

4.1 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 indicator and the TTWA trade-weighted services barrier exposure mea-

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[37]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.

sure, and column (2) additionally includes the tariff exposure measure. Columns (3)-(5) sub-sequently 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% 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% decrease in monthly postings.

The estimated coefficient on the interaction with the tariff measure is close to zero and insignificant across all specifications.[38] Other control variables also fail to reach statistical significance.

Table B7 in the Online Appendix repeats the OLS results instead using weighted least squares, taking annual postings at the TTWA level in 2015 as the weights. When weighted, the estimated magnitudes are smaller, but all the estimated coefficients on services remain significant at the 5% level.

It is worth noting that our specifications focus on the impact of barrier exposure on total postings across all sectors. Therefore, it captures both the direct impact of services barriers on professional services firms as well as an indirect effect working, for example, through a reduction in the demand for cafes, restaurants, and shops surrounding workplaces affected directly.

4.2 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. Following recent developments in the event study literature (Borusyak et al. (2022b)), we omit the first quarter (Q1 2015) as well as the quarter immediately preceding the referendum (Q1 2016). As before, we control for the EU immigrant share and

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[38]Note that the tariff measure would remains insignificant even if it entered the specification alone. See Table B8 in the Online Appendix.

Table 1: Baseline post-vote results

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * service barrier exposure	-0.538***	-0.540***	-0.559***	-0.553***	-0.557***
	(0.132)	(0.132)	(0.134)	(0.127)	(0.133)
post vote * tariff exposure		-0.008	-0.029	-0.029	-0.029
		(0.033)	(0.055)	(0.055)	(0.054)
export REER			-0.135	-0.136	-0.141
			(0.146)	(0.146)	(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. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

tariff exposure interacted with the post-vote dummy and export exchange rate control, and for month-year and TTWA fixed effects.[39]

Three observations emerge from the estimates depicted in Figure 5. First, the pre-referendum coefficient estimates are close to zero and not statistically significant, which is consistent with the absence of pre-trends. Second, there is an immediate short-lived reaction during the quarter of the referendum followed by three quarters with next to no impact (with the coefficients remaining close to zero and being either weakly significant or insignificant). The short-lived reaction during the referendum quarter took place during the referendum month (see Figure A9 in the Online Appendix). The lack of meaningful response during the three quarters following the referendum is consistent with the view that the surprising outcome of the referendum meant that the was no unified vision in the Conservative Party of what the post-Brexit future would look like.[40] However, the doubts that may have existed with regard to the Government's commitment to implement the referendum outcome were largely seen to

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[39]Allowing for interactions of the control variables with quarterly dummies does not affect the results (see Figure A10 in the Online Appendix). We estimate the event study with quarterly interactions to smooth out fluctuations, but also provide the equivalent event study with monthly interactions in Figure A9 in the Online Appendix. Both approaches lead to similar conclusions, though the monthly interactions provide a more noisy picture.

[40]This lack of unified vision within the Conservative Party eventually led to Theresa May's resignation from the prime ministerial post.

have been 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 strongly 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 the 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 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% of the British economy, including financial services."[41] 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 A11 in the Online Appendix, shows that the quarterly interactions were insignificant until Q2 2018, after which they point to large negative and statistically significant effects, 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

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[41]https://www.ft.com/content/702ac352-85bc-11e8-96dd-fa565ec55929
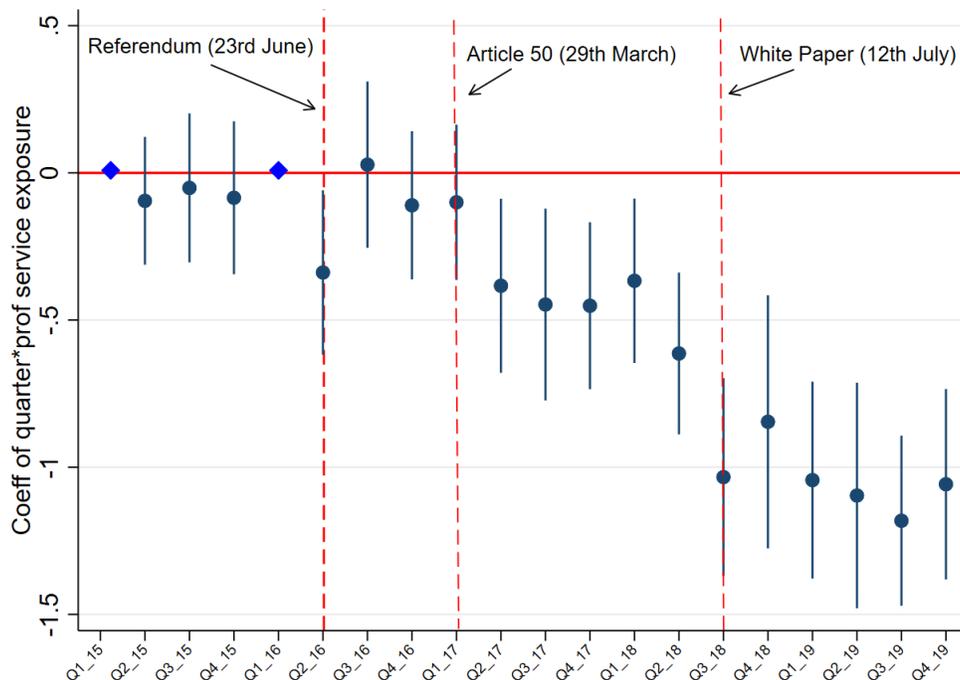
Figure 5: Impact of professional services exposure over time

Notes: This graph shows the coefficients from the regression of the log of monthly job postings at the TTWA level on the professional services barrier exposure measure at the TTWA level interacted with a dummy variable for each quarter from Q1 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 the period before the vote, Q1 2016. These omitted periods are represented by a blue diamond. The dots represent the point estimates and the lines the 90% confidence intervals. The red line shows the quarter when the referendum occurred, Q2 2016.

the Single Market.[42]

4.3 Impact on different skill groups and occupations

The UK has a comparative advantage in exports of skill-intensive services, so we would expect postings for higher skilled jobs to be affected more than lower skilled postings. We test this by estimating our baseline specification separately for higher skilled and lower skilled job adverts as defined in Section 3.3. The estimation results are presented in Table 2, where panel (a) displays the results for higher skilled job adverts, while panel (b) shows the results for lower skilled job adverts.

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[42]An equivalent event study for tariff exposure yielded no quarter with statistically significant coefficients and so is not displayed.

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***	-0.635***	-0.649***	-0.642***	-0.647***
	(0.132)	(0.132)	(0.133)	(0.127)	(0.132)
post vote * tariff exposure		0.009	-0.006	-0.006	-0.006
		(0.032)	(0.050)	(0.050)	(0.050)
export REER			-0.097	-0.098	-0.105
			(0.134)	(0.134)	(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**	-0.283**	-0.297**	-0.298**	-0.296**
	(0.127)	(0.127)	(0.128)	(0.122)	(0.127)
post vote * tariff exposure		-0.017	-0.032	-0.032	-0.032
		(0.037)	(0.056)	(0.056)	(0.056)
export REER			-0.094	-0.094	-0.096
			(0.140)	(0.140)	(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.

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

To understand these results further, we next estimate our baseline specification for each of the nine occupational (SOC) groups separately.[43] The estimation results are summarized in Table 3 below. Consistent with the results by skill group, we find the strongest negative and statistically significant effects of exposure to barriers on professional services exports for three out

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[43]The classification of occupations is described in Section 3.3 with further details in Table B3 in Online Appendix.

of the nine occupations, all of which are classified as 'high skilled' above. 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 (hereafter termed 'production workers'), which is classified as a lower skilled occupation. This occupational 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. Table B9 in the Online Appendix reestimates the baseline Table 1 replacing total postings with posting for production workers. The tariff exposure coefficient is positive and significant once the exchange rate control is included. In contrast, exposure to services export barriers does not seem to matter for posts for production workers, which is exactly what we would expect to observe.

4.4   Back-of-the-envelope calculation of aggregate effects

We do a back-of-the-envelope counterfactual exercise based on the event study presented in Figure 5, using the statistically significant exposure coefficients in the post-referendum period. This generates a total loss of 2,652,219 job postings over the entire post-vote period.[44] This is equivalent to the average of 63,148 job postings lost per month across all TTWAs, or the average of 296 per TTWA. The mean monthly number of job adverts posted prior to the Brexit vote across all TTWAs was 535,397, so this effect implies an 11.8% loss in monthly job adverts on

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[44]For reference, the size of the UK labour force is approximately 34 million.

Table 3: Barrier exposure impacts by occupation

Dep var: log SOC postings	1. Managers, Directors and Senior Officials (H)	2. Professional Occupations (H)	3. Associate Professional and Technical Occupations (H)
post vote * prof services exposure	-0.551***	-0.798***	-0.532***
	(0.130)	(0.146)	(0.149)
post vote * tariff exposure	-0.048	0.052	-0.032
	(0.046)	(0.053)	(0.051)
Adjusted R-squared	0.984	0.962	0.977
	4. Administrative and Secretarial Occupations (L)	5. Skilled Trades Occupations (H)	6. Caring, Leisure and Other Service Occupations (L)
post vote * prof services exposure	-0.017	-0.220	-0.173
	(0.134)	(0.153)	(0.121)
post vote * tariff exposure	-0.049	-0.042	0.020
	(0.030)	(0.035)	(0.038)
Adjusted R-squared	0.970	0.962	0.953
	7. Sales and Customer Service Occupations (L)	8. Process, Plant and Machine Operatives (L)	9. Elementary Occupations (L)
post vote * prof services exposure	-0.243	-0.175	-0.173
	(0.151)	(0.157)	(0.172)
post vote * tariff exposure	-0.050	-0.082**	0.037
	(0.032)	(0.040)	(0.075)
Adjusted R-squared	0.962	0.977	0.970
Observations	12,780	12,780	12,780
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. (H) and (L) denote whether the occupation group is classified as higher skilled or lower skilled in the skill classification. 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. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

average in the post-referendum period.

5. Additional results and mechanisms

5.1 A focus on financial services

Financial services are of particular importance for the UK economy. This industry alone accounted for 42% 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 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:

$$RegionalFSexposure_{NUTS1} = \frac{RegionalFSExportstoEEA_{NUTS1,2015}}{L_{FS,NUTS1,2015} \times avgSTRIgap_{FS,2014}} \tag{8}$$

where $avgSTRIgap_{FS,2014}$ is the trade-weighted STRI gap for financial services, $RegionalFSExportstoEEA_{NUTS1,2015}$ 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:

$$FSexposure_{r,NUTS1} = FSemplshare_{r,2015} \times RegionalFSexposure_{NUTS1} \tag{9}$$

where $FSemplshare_{r,2015}$ is the financial service share of TTWA r employment in 2015.

Table 4: Financial services post-vote baseline

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * financial services exposure	-1.201***	-1.201***	-1.225***	-1.211***	-1.208***
	(0.296)	(0.295)	(0.302)	(0.293)	(0.300)
post vote * tariff exposure		-0.00271	-0.0176	-0.0179	-0.0174
		(0.0328)	(0.0525)	(0.0523)	(0.0522)
export REER			-0.0981	-0.0985	-0.102
			(0.142)	(0.142)	(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.

Figure A4 in the Online Appendix displays a map illustrating geographic variation in the exposure measure, while Figure A5 in the same appendix 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 measure 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% decrease in monthly postings.

It is worth noting that our specifications focus on the impact of financial service exposure on total postings across all sectors. This would therefore include the spillover effects from the direct impacts on financial services, for example through a reduction in the demand for cafes, restaurants, and shops surrounding the financial institutions that face these direct effects.

Figure A12 in the Online Appendix displays the estimates from the regression of job post-

ings on the financial services exposure measure interacted with quarter dummies. The results are similar to those found earlier for the professional services (Figure 5). As before, there is no evidence of pre-trends. There is short-lived reaction in the quarter of the referendum and then 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 B10 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 B11 in the same 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, construction and building trades and even food preparation and hospitality trades, suggesting an effect on the business ecosystem serving the financial industry.

5.2 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. Section 7 In the Online

Appendix presents some results using 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 3.7.1.[45] Results 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, but are less conclusive than for online job adverts, with a discussion provided of potential explanations for this.

5.3   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 explore 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 spillover 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. For robustness, we also construct spillover exposures uses the inverse distance squared, the inverse distance

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[45]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.

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capped at 100km, and the inverse distance capped at 200km.[46]

The results, presented in Panel (a) of Table 5, show that the professional services spillover exposure coefficient is negative and statistically significant across different methods of constructing the exposure. In Panel (b), we split this variable up into two components: the baseline own province professional service exposure, and the spillovers not including own province. 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. 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.[47] 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.

5.4 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

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[46]To calculate spillover exposure of a particular TTWA ('own province'), we sum up the individual exposure of all TTWAs using a weighting which puts more emphasis on TTWAs that are closer to the own province. For example, using an inverse distance weighting means that TTWAs that are further from the own province receive a lower weighting. For the standard spillover measure in Panel (a) of Table 5, we assume that each province is circular in shape and use half the radius of the own province for its own weight.

[47]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.

Dep variable: log postings

	Panel (a)			
	(1) Inv. dist.	(2) Inv. dist.^{2}	(3) Inv. dist. <100km	(4) Inv. dist. <200km
post vote * service barrier exposure spillover	-1.308** (0.493)	-13.54*** (4.186)	-1.223** (0.463)	-0.922* (0.464)
post vote * tariff exposure spillover	-0.559*** (0.205)	-2.742** (1.129)	-0.574** (0.225)	-0.562*** (0.190)
Exchange rate spillover	-1.241*** (0.395)	-7.557** (3.233)	-1.319*** (0.465)	-1.112*** (0.351)
EU worker share spillover	0.509 (1.678)	15.34 (17.67)	-0.265 (1.831)	0.268 (1.414)
	Panel (b)			
post vote * service barrier exposure	-0.644*** (0.119)	-0.614*** (0.119)	-0.655*** (0.116)	-0.681*** (0.123)
post vote * service barrier exposure spillover (excl. own province)	0.764 (0.792)	9.866 (18.70)	0.574 (0.675)	1.128 (0.722)
post vote * tariff exposure spillover	-0.651*** (0.202)	-2.588** (1.053)	-0.578*** (0.215)	-0.667*** (0.187)
Exchange rate spillover	-0.978** (0.384)	-5.050* (2.890)	-0.947** (0.452)	-0.873** (0.343)
EU worker share spillover	-2.263 (2.064)	-1.612 (18.20)	-1.802 (1.996)	-2.383 (1.755)
	Panel (c)			
post vote * tariff exposure	-0.0234 (0.0419)	-0.0108 (0.0394)	-0.0245 (0.0431)	-0.0196 (0.0404)
post vote * tariff exposure spillover (excl. own province)	-0.851*** (0.257)	-15.21* (8.042)	-0.878*** (0.270)	-0.827*** (0.221)
post vote * service barrier exposure spillover	-0.970* (0.491)	-10.10*** (3.784)	-0.975** (0.456)	-0.611 (0.469)
Exchange rate spillover	-1.245*** (0.378)	-4.011 (3.069)	-1.250*** (0.427)	-1.143*** (0.335)
EU worker share spillover	0.693 (1.625)	18.69 (17.24)	0.238 (1.790)	0.346 (1.356)

Notes: This table displays the results from the regressions of the log of monthly job postings in each TTWA on the trade barrier spillover exposure measures interacted with the post vote dummy variable. Each column uses a different distance weighting for constructing the spillover exposure. 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.

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:

$$\log(\text{postings}_{rt}) = \beta_0 + \beta_1 tradebarrierthreat_r \times uncertainty_t + \mathbf{X}'_{rt}\boldsymbol{\beta}_2 + \gamma_t + \gamma_r + \epsilon_{rt} \qquad (10)$$

where $uncertainty_t$ is one of four measures of uncertainty pertaining to month-year t. Each specification includes a full set of controls, alternating between the EU national share and EU8 national share interacted with uncertainty as well as exchange rate.

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 7 provides more detail on their construction along with a short discussion on uncertainty versus expectations. Our analysis covers the negotiation period starting in September 2016, which is the first date for which the Brexit Uncertainty Index (BUI) is available.[48] Table 6 presents the results for four uncertainty indices.

As before, the coefficients on interactions with professional services exposure are negative and statistically significant in all specifications. They reach a one% significance level for the Google, BUI and Brexit Risk indices, whereas the estimates for the Newspaper index are statistically significant only at the 10% 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% 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%, for the Brexit Risk measure a decrease of 1.4% and for the Newspaper measure a decrease of 1.8%.[49]

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.

5.5   Discussion: Why stronger findings for services than for goods trade?

Taken together, our results suggest that the threat of unravelling deep integration with a country's major trading partners can have substantial effects on the labour market through the reduced number of job openings. For the UK, it was the threat of barriers on trade in services,

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[48]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.

[49]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.

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***	-0.040***	-0.141***	-0.172***	-0.232***	-0.269***	-0.066*	-0.082*
	(0.007)	(0.007)	(0.050)	(0.051)	(0.058)	(0.060)	(0.039)	(0.042)
measure *tariff exposure	-0.001	0.000	0.005	0.011	-0.007	-0.001	0.009	0.012*
	(0.002)	(0.002)	(0.010)	(0.010)	(0.011)	(0.011)	(0.006)	(0.006)
measure*EU national share	-0.264***		-1.585***		-1.907***		-0.826***	
	(0.042)		(0.281)		(0.349)		(0.239)	
measure*EU8 national share		-0.414***		-2.394***		-2.901***		-1.246***
		(0.062)		(0.414)		(0.523)		(0.399)
export REER	0.390	0.410	0.124	0.148	0.342	0.346	0.367	0.356
	(0.369)	(0.376)	(0.404)	(0.411)	(0.394)	(0.398)	(0.413)	(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	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 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.

and particularly financial services, that mattered the most, rather than the threat of barriers on goods trade, despite the greater prominence of tariffs and manufacturing supply chains in the public debate on the economic implications of Brexit.

This is not to say that the threat of higher export tariffs on goods did not matter. Recall that we find a negative effect on job postings for plant and machine operators. This occupational category encompasses manufacturing workers, the exact group for whom barriers to exporting goods would have the largest impact. And the estimated effect is economically meaningful: a one standard deviation increase in exposure to tariffs corresponds to a 3.6% decline in job postings for this group. Moreover, we find that the threat of tariffs matters when we extend the analysis to take into account a larger geographic area and thus potential production networks. Again, the estimated effects are substantial: a one standard deviation increase in (inverse distance) weighted exposure of neighbouring TTWAs translates into 7.8% fewer jobs posting.

The contrast between the findings for services and goods barriers can be due to the much larger magnitude of the expected barriers to services trade, as compared to goods trade. For instance, according to the estimates of Benz and Jaax (2022), the difference between the ad valorem equivalents (AVEs) of barriers in financial services within the EEA versus barriers among WTO members (not trading on preferential terms) was on average 183%. The correspond-

ing figure for the insurance sector was 177%. This contrasts sharply with the EU's external tariff of 3.3% in 2016. While non-tariff barriers add to the anticipated additional trade costs, we find a trade weighted sectoral average of the ad valorem equivalents of only 2.4%, relative to 1.4% for tariffs, with the sum of both (at 3.03% on average) remaining significantly lower than the AVEs of services barriers.[50] Table B8 of the appendix, discussed further in section 6.6, presents robustness exercises which incorporate non-tariff barriers (both in count and ad valorem equivalent format). The related goods barrier coefficients remain non-significant, while the professional services coefficients remain significant with minimal variation from the baseline.[51]

Moreover, the White Paper published by the UK Government in July 2018 clearly stated its intentions to negotiate a free trade agreement for goods, while accepting barriers to services trade that would be an inevitable consequence of the intended regulatory divergence ('freedom to chart its own path') mentioned in the paper. While the White Paper has not eliminated uncertainty about the outcome of negotiations with the EU, it clearly indicated the desired direction of these negotiations, sending a clear positive signal to the manufacturing industry and a clear negative signal to services sectors.

Finally, it is worth noting that only 8% of the total UK employment is accounted for by manufacturing, as compared to 43% being found in professional services.[52]

6. Robustness and extensions

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

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[50]Data on AVEs of non-tariff barriers sourced from: https://datacatalog.worldbank.org/search/dataset/0040437.

[51]Our results are also in line with recent work by Freeman et al. (2022) who conducted an ex post analysis of the period between the vote and the implementation of the new Trade and Cooperation Agreement (TCA) in 2021, and found no evidence that uncertainty and anticipation effects led to a significant decline in relative UK goods trade with the EU (the authors leave an evaluation of services trade to future work).

[52]And, of course, there always exists the possibility of measurement error introducing the downward bias in the estimated coefficients for both services and goods barrier exposure.

6.1 Placebo tests, random exposure and regional time trends

One potential concern could be that our baseline difference-in-differences results are driven by time-varying unobservables that are not absorbed by month-year fixed effects. To explore this possibility we conduct a placebo test, in which 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 B12 in the Online Appendix presents the results of this alternative placebo test using pre-referendum postings. The coefficients on services exposure are not significant in any of the specifications, suggesting that this impact was not observed prior to the referendum.

We also follow Miller et al. (2021) in conducting a placebo in which the assignment of pre-vote professional services barrier exposure across TTWAs is randomly assigned. We repeat this exercise 10,000 times and compile the coefficient estimates and t-statistics from our baseline specification, with results shown in Figure A14 in the Online Appendix. The vertical lines indicate the 5th and 95th percentiles of this 'placebo' distribution; our model estimate is depicted with a dashed line. This exercise allows us to further investigate the likelihood that we might encounter similarly sized effects by chance. Our estimates fall well below the 5th percentiles of the distributions of placebo coefficient estimates and t-statistics, further increasing our confidence that we are estimating a true effect.[53]

In addition, to allay any remaining concerns, we also include regional (NUTS1) linear time trends at the year-month level to ensure that our results are not driven by regional trends that coincided with the Brexit vote and are correlated with trade barrier exposure. The results are shown in Table B13 in the Online Appendix. Even with these time trends, the variables of interest remain statistically significant to the 1% level, while coefficients drop in magnitude only

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[53]We also note that we are not able to repeat a similar triple-difference placebo model as these authors as our dataset doesn't allow for a similar placebo group for comparison.

slightly.

6.2 Excluding London

Another potential concern is that the estimated impact was primarily driven by London. First, Figures 3 and A3 show that the professional services exposure is actually not as concentrated in London as is often presumed. Additionally, Table B14 in the Online Appendix 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 A4 of the Online Appendix. Excluding London does not have much impact on the results for financial services exposure either, as is shown in Table B15 in the Online Appendix.

To further address concerns that any one TTWA is driving the results, we rerun column (4) of Table 1 (baseline) and Table 4 (financial services) excluding each TTWA in turn and generating 213 regressions for each table. The coefficient of post vote * service barrier exposure remains significant at the 1% level across all regressions with a magnitude which remains very close to the specifications including all TTWAs.[54]

6.3 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.

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[54]To save space we do not report the results of all 426 regressions

Table B16 in the Online Appendix repeats the baseline analysis but includes these shares. The professional services measure remains significant across all specifications, while the associated share is positive and significant at the 10% level in all 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% relative decline in monthly postings. Figure A13 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.

6.4   Shift-share robustness

We conduct further tests and analysis to shed light on the validity of our shift-share approach. We argue that the shift component of our exposure variables is plausibly exogenous, as the referendum result was unexpected and the size of the potential change in barriers was largely set during negotiations over two decades earlier (as the vast majority of GATS commitments entered into force on 1 January 1995). A potential concern in such a setting is that unobserved industry shocks may affect regional outcomes through the same mixture of exposure shares as those relevant to the observed shocks. Therefore, we consider the framework of Borusyak et al. (2022a), which speaks to the case of exogenous shifts and potentially endogenous shares, to be the appropriate approach to follow.

The first issue raised in Borusyak et al. (2022a) relates to incomplete shares, i.e., when the employment shares corresponding to the shock being examined do not add up to one. This is the case in our context, as the employment shares are fractions of total TTWA employment,

while the services shock is non-zero only for professional services. Therefore, as suggested by these authors, in Table B17 in the Online Appendix, we present diagnostic statistics for the sectoral-level shocks computed with importance weights based on initial 2015 employment shares. Column (1) shows that inclusion of the "missing" zero-valued shock in other industries leads to an unusual distribution of the shocks with an interquartile range of zero, along with an effective sample size (inverse Herfindhal index) of only 67 and a mean close to zero. Removing the zero shock in column (2) leads to much more reasonably behaved summary statistics, for example a large effective sample size of 509 and a much larger interquartile range and mean (0.0013 and 0.0015, respectively). We also note that the largest s_{nt} weight in column (2) is very small at only 0.35%, which suggests a sizable degree of variation at the industry level. Residualizing professional services shocks on period indicators in column (3) does not change the picture in a meaningful way. In such a situation, Borusyak et al. (2022a) recommend including the initial TTWA-specific employment share of professional services. However, our regressions already include TTWA fixed effects that implicitly already control for it.

The next set of recommended diagnostics are falsification tests of shock orthogonality. Table B18 in the Online Appendix reports the results of region-level balance tests, where we regress industry-level and region-level potential confounding covariates on the professional services exposure shocks (both interacted with the post-vote dummy, allowing for TTWA and period fixed effects). These covariates are chosen to represent the composition or productivity of an industry or a region's workforce. The industry-level covariates include: the initial 2015 capital stock, the total sectoral wage bill, and share of workers with a university degree or higher.[55] The TTWA-specific covariates are: the initial share of the population with National Vocational Level 4 or higher (NVQ4+, corresponding to a certificate from a higher education

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[55]The initial capital stock and wage bill are measured in USD millions and taken from the OECD STAN database: https://stats.oecd.org/Index.aspx?DataSetCode=STANI4_2020. The share of university degrees is taken from the ONS Labour Force Survey ((https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes) and based on workers with International Standard Classification of Education (ISCED) level 6 or higher.

institution),[56] foreign-born population, employment among women, employment in routine occupations, employment in medium or large enterprises as well as growth in professional services employment in the pre-sample period (2012-14).[57]

In terms of regional balance, we detect imbalance only in terms of the pre-sample professional services employment growth, whose coefficient is statistically significant at the 5% level. All other coefficients in the lower panel of the table do not reach standard significance levels. As for the industry-level balance, the coefficient on wages is not statistically significant, while the coefficients on the capital stock and the share of workers with a degree are statistically significant at the 5% and the 10% level, respectively. Given these results, in the next exercise we additionally control for interactions of these covariates with the post vote dummy.

The last robustness check requires converting the region-level regression to an equivalent industry-level regression in order to obtain valid exposure-robust standard errors. As visible in Table B19 in the Online Appendix, our findings are robust to this test. Column (1) recreates the baseline regression with no controls and clustering at the SIC 2 digit level, while column (2) includes the regional controls from the balance table, column (3) includes the associated industry controls, and column (4) includes both. In all cases, the coefficient of the exposure variables remains significant at the 1% level, with column (2) showing a coefficient which is somewhat larger in terms of magnitude, column (3) showing a somewhat smaller magnitude. Once all of the controls are included, column (4) shows a similar magnitude coefficient to the baseline (0.650 as opposed to 0.585).

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[56]See https://www.gov.uk/what-different-qualification-levels-mean/list-of-qualification-levels for more information

[57]The education level, foreign-born population, employment among women, employment in medium or large enterprises and professional services employment growth are all taken from the ONS. Employment in routine occupations is based on Acemoglu and Autor (2011) who use ONET job characteristics to develop "routine" scores for occupations which are then weighted using TTWA occupation shares.

6.5 Alternative definition of services exposure

In this section, we redefine our measure of services exposure. Instead of weighting the STRI gap by sectoral exports to the EEA per worker (as in equation (2)), we weight it by the ratio of exports to the EEA per unit of sectoral output. The baseline approach of weighting by exports per worker aims to capture the probability that an individual worker in sector j works for a firm exporting to the EEA, while region-specific employment shares used as weights in equation (3) can be interpreted as the probability that an individual worker is employed in a given sector in a given TTWA. The alternative approach of weighting by exports per unit of output captures the importance of exports to the EEA in the GDP of that sector, rather than employment in that sector. As is evident from the top panel of Table B20 in the Online Appendix, our findings are robust to using the alternative definition of services exposure. In column 4 of panel a in this table, a one standard deviation increase in this exposure measure (0.0012) results in a 6.3% decline in online postings after the vote, similar to the 4.9% found in the same specification in our baseline results. They are also robust to applying this definition to both services and goods barriers exposure (see the bottom panel).

6.6 Barriers to trade in goods: robustness checks

There are many ways in which tariff exposure has been measured in the literature. Table B21 in the Online Appendix 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.[58] 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 $ln(1 + MFNtariff_p)$ before applying weightings but oth-

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[58]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.

erwise 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.

Further robustness checks related to tariffs are presented in Table B8 in the Online Appendix. In panel (a), we start with the tariff exposure and one by one add additional controls. Doing so has no impact on the findings. The tariff exposure does not reach conventional levels of statistical significance, while the services exposure remains negative and significant at the one percent level.

Although tariffs are the most conspicuous trade barrier for goods, non-tariff barriers (NTBs) may also matter for trade in goods. In order to investigate this possibility, we first 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 exposure. We use data from WITS, which provides a list of MFN non-tariff barriers per product at the 8-digit HS level. We first calculate the count of barriers that each HS8 product would be exposed to under MFN terms and then take a simple average at the HS6 level to match the level of aggregation in our COMTRADE export data. This measure is then weighted by each product's share of exports to the EU before replacing the $avgMFNtariff_{j,2014}$ in equation (4). It enters the regression together with the original tariff exposure measure. As visible in panel (b) of Table B8, neither tariff exposure nor NTB exposure appear to be statistically significant in any specification, while our main finding on services exposure remains robust.[59]

Additionally, we calculate goods exposure measures using 2015 ad valorem equivalents (at the HS6 level) from the World Bank.[60] Panel (c) presents the results for separate tariff and NTB

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[59]The same is true in additional specifications shown in Online Appendix Table B22.

[60]The methodology is based on Kee and Nicita (2018), which in turn, builds on the work of Kee, Nicita and Olarreaga (2009)

ad valorem equivalent exposure measures, and panel (d) shows teh results for the combined measure. In both cases, there is no evidence of an impact of goods barriers on job postings.

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. (2018b), 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.[61] We then include three weighted average measures for each of these three trade barriers as a robustness check on our results. Table B23 presents the baseline results with these measures included, demonstrating that including these measures has very little impact on our results.

Finally, it is worth recalling that we found statistically significant and economically meaningful results for production workers. See discussion in Section 5.5.

6.7   Protection from imports

As argued in the introduction, Brexit was not driven by protectionist motives with respect to trade and throughout the process the UK authorities often expressed their desire to keep import barriers low. Nevertheless, for completeness, we also examines whether the possibility of the UK introducing tariffs on imports from the EU under a no deal scenario had an impact on job postings. We construct two measures of tariff exposure, one accounting for protection of UK industries from international competition, and the other accounting for the increased cost of imported inputs for UK firms, with more details provided in the Online Appendix. As visible

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[61]WTO Tariff Analysis Online: https://www.wto.org/english/tratop_e/tariffs_e/tariff_data_e.htm

in Table B24 in the Online Appendix, neither of the two measures appears to be statistically significant, whether entered alone or with a full set of controls (see columns 1 - 3), and our main result remains robust.

We also investigate whether the possibility of the UK introducing barriers to imports of professional services from the EU mattered for job postings (see the Online Appendix for details). As illustrated in columns 4 and 5 of Table B24 in the Online Appendix, high exposure to such potential barriers had a negative and statistically significant effect on job postings, but introducing this additional control does not affect our main result. These results most likely reflect the fact that being a professional services hub requires a two-way trade in services.[62] Having said that, we do not want to overinterpret these findings, as the import and export exposures in services are highly correlated.

6.8 Spatial correlation

To address concerns of spatial correlation, we employ HAC standard errors, as discussed in Conley (1999) and Conley (2008), as opposed to two-way clustering at the TTWA and month-year levels. These standard errors allow for observations to not be independent from each other based on spatial proximity. We apply a cutoff distance of 200km for potential dependence. Table B25 in the Online Appendix presents the results. The significance of our baseline findings remains unaffected. Additionally, we experiment with clustering by TTWA only, as opposed to TtWA and year-month in our baseline specifications. These results are displayed in Table B26 in the Online Appendix. Clustering only by TTWA lowers the standard errors slightly, resulting in more statistically significant coefficients.

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[62]For example, the ONS's input-output table shows that in 2014 a third of the imported inputs of the financial services industry were of financial services and half of the imported inputs of the telecommunication services industry were of telecommunication services.

7. 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% on average in the post-referendum period. We show that these results hold when 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. A back-of-the-envelope counterfactual calculation suggests that the aggregate impact of this exposure implies a cumulative half a 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.

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 services on the posting of job adverts, that also affected higher skilled job adverts more than lower skilled adverts.

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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 EU tariffs on UK exports 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 tariffs. One is that while MFN tariffs in some cases can be large, 63% of HS-6-digit product lines would have tariffs below 5%. 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 (8% 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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Online Appendix

Appendix A: Additional maps and figures
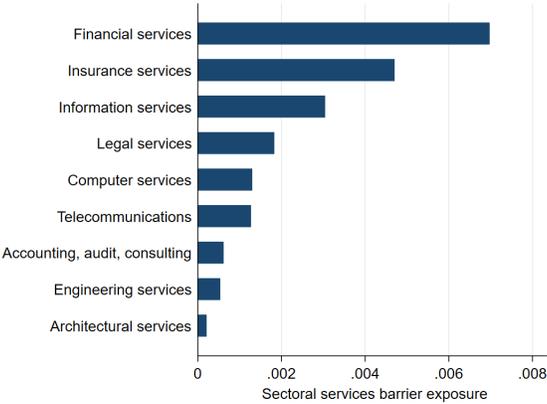
Figure A1: Services trade barrier exposure at the industry level

Notes: This chart presents the professional services barrier exposure measure at the industry level, by industry. This measure includes the weighting by exports to the EEA by employment. This measure is as outlined in equation (2). *Sources*: OECD (STRI), UK ONS (incl. BRES), Comtrade.
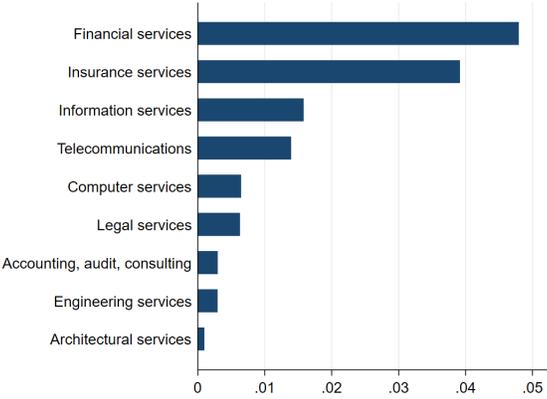
Figure A2: Tradability measure at the industry level

Notes: This chart presents the measure of the ratio of exports to the EEA by employment by industry. This measure is as outlined in the first component of equation (2). *Sources*: UK ONS (incl. BRES), UN Comtrade.
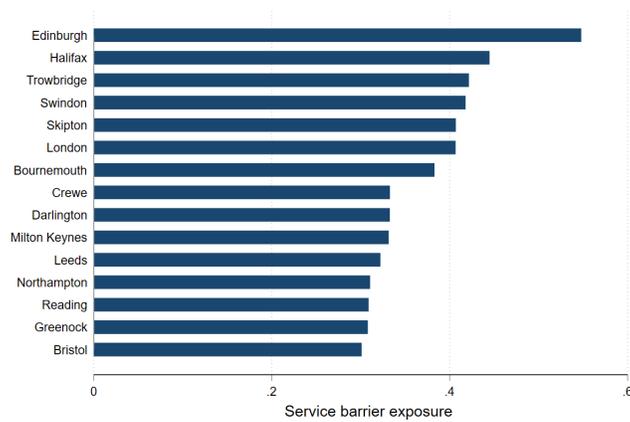
Figure A3: Most exposed Travel to Work Areas: professional services trade barriers

Notes: This chart presents the employment-weighted professional services exposure for the top 15 most exposed TTWAs. *Sources*: OECD (STRI), UK ONS (incl. BRES), Comtrade.
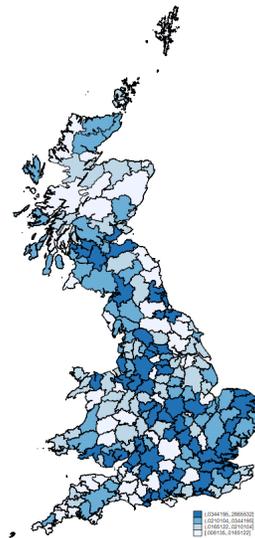
Figure A4: Financial service exposure map

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. *Sources*: OECD, UK ONS.
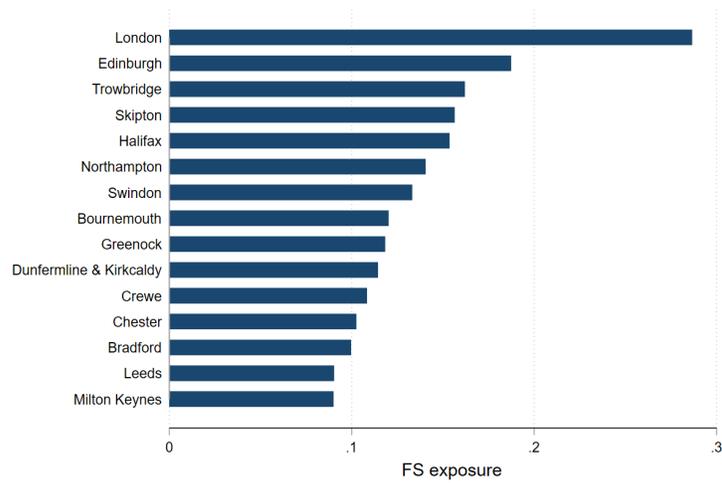
Figure A5: Most exposed TTWAs: Financial Services

Notes: This chart presents the employment-weighted financial services exposure measures for the top 15 most exposed TTWAs.
Sources: OECD, UK ONS.
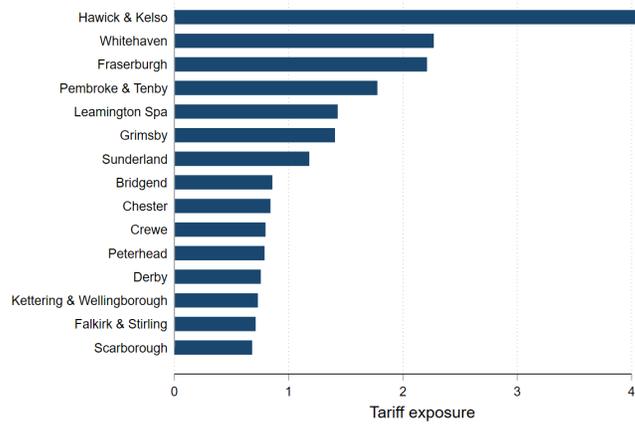
Figure A6: Most exposed Travel to Work Areas: Tariff Barriers

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

(a) EU national share   (b) EU8 national share
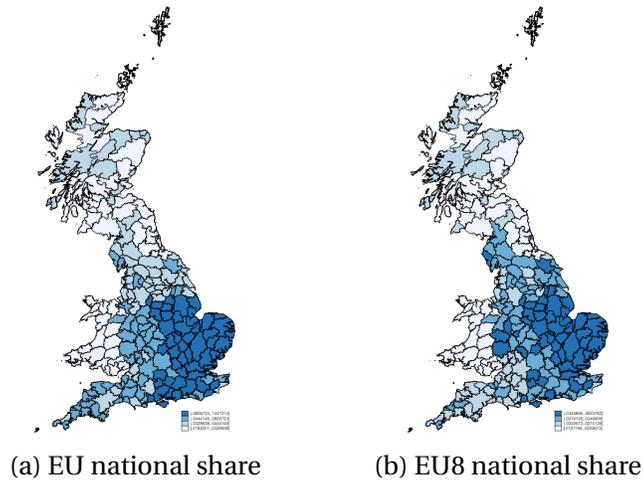
Figure A7: Exposure to immigration

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. *Sources*: UK ONS.
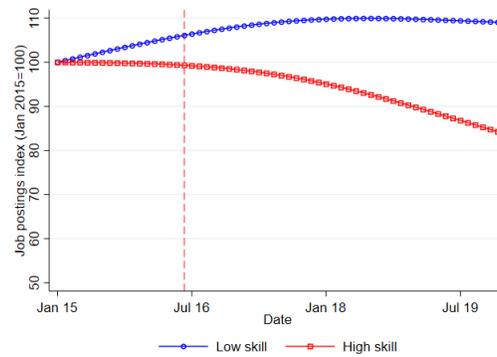
Figure A8: High skilled and low skilled job postings over time

Notes: Both trend lines are smoothed using the Hodrick-Prescott time-series filter, removing cyclical components, and nor-malised to 100 in January 2015 for comparison. The vertical red dotted line identifies the date of the Brexit referendum. *Sources*: Burning Glass Technologies.
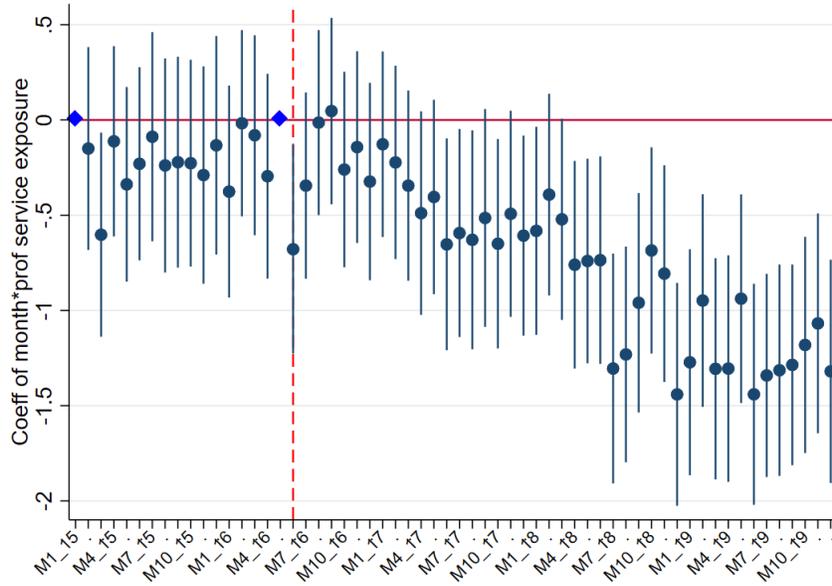
Figure A9: Professional services exposure event study monthly

Notes: This graph shows the coefficients from the regressions of the log of monthly job postings at the TTWA level on the professional services exposure measure interacted with a dummy variable for each month from January 2015 to December 2019. Coefficients are relative to the base period of the first period (Jan 2015) and period before the shock (May 2016), which are denoted with a blue diamond. The regressions also control 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.
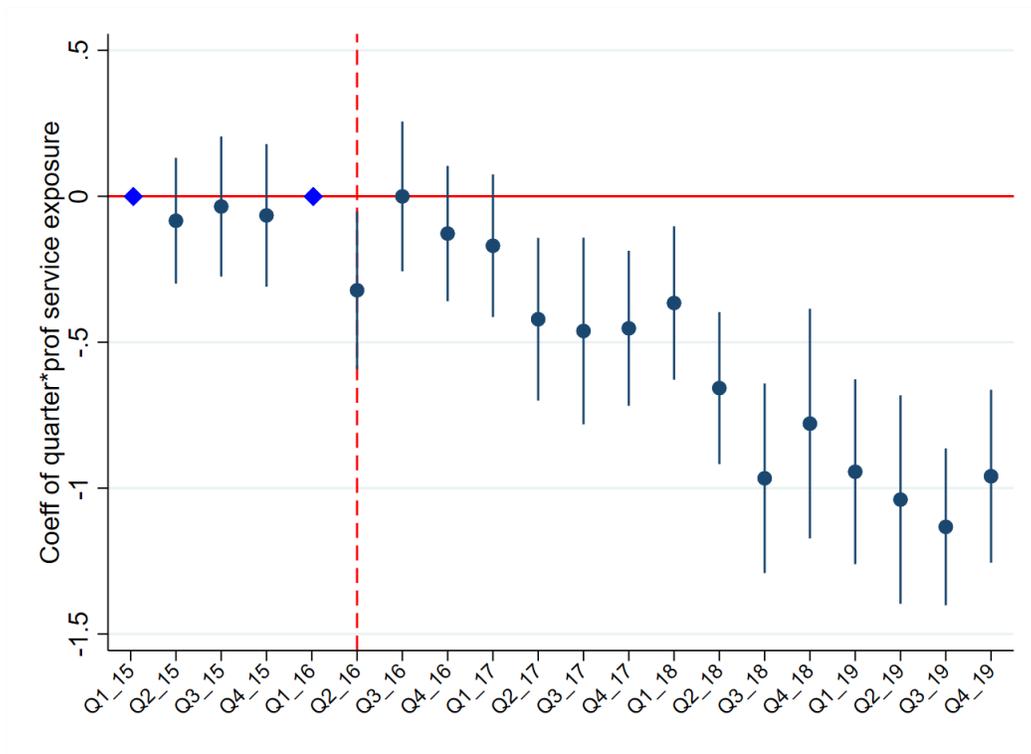
Figure A10: Professional services exposure event study with quarterly controls

Notes: This graph shows the coefficients from the regressions of the log of monthly job postings at the TTWA level on the professional services exposure measure interacted with a dummy variable for each month from January 2015 to December 2019. Coefficients are relative to the base period of the first period (Q1 2015) and period before the shock (Q1 2016). The regressions also control for the EU immigrant share and tariff exposure interacted with quarterly 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.

(a) EU national share
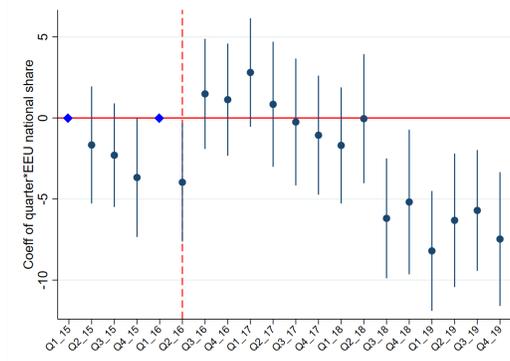
(b) EU8 national share

Figure A11: Impact of EU immigration exposure over time

Notes: This graph shows the coefficients from the regressions of the log of monthly job postings at the TTWA level on the EU immigration exposure measure interacted with a dummy variable for each quarter from Q1 2015 to Q4 2019. Coefficients are relative to the base period of the first period (Q1 2015) and t-1 (Q1 2016). 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.
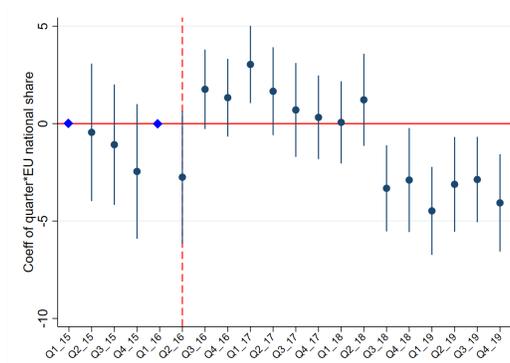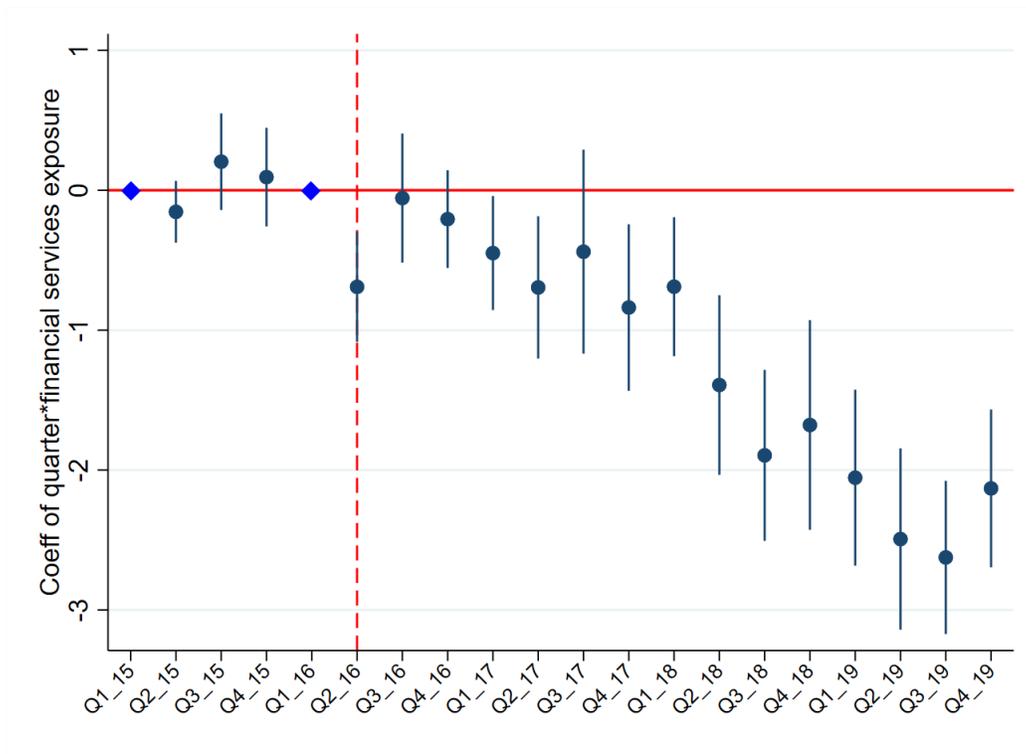
Figure A12: Impact of financial services exposure over time

Notes: This graph shows the coefficients from the regressions of the log of monthly job postings at the TTWA level 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 the base period of the first period (Q1 2015) and t-1 (Q1 2016). 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.
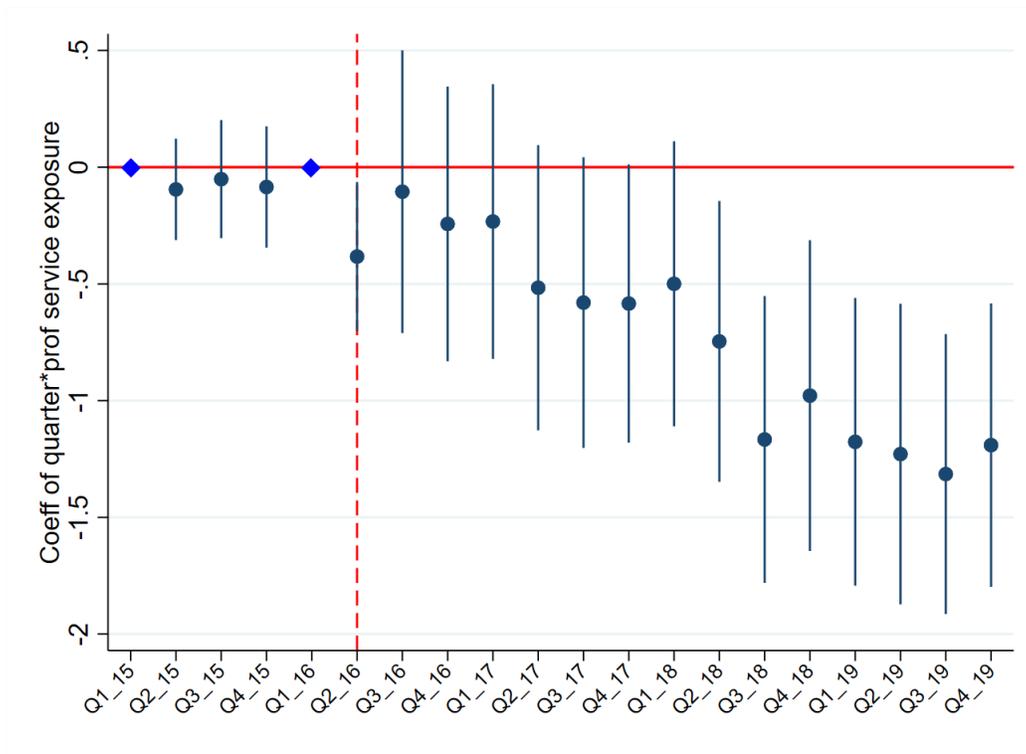
Figure A13: Impact of professional services exposure with share controls

Notes: This graph shows the coefficients from the regressions of the log of monthly job postings at the TTWA level on the professional services exposure measure interacted with a dummy variable for each quarter from Q1 2015 to Q4 2019. Coefficients are relative to the base period of the first period (Q1 2015) and t-1 (Q1 2016). 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.

(a) Coefficient Estimates　　　　　　　　(b) T-Statistics
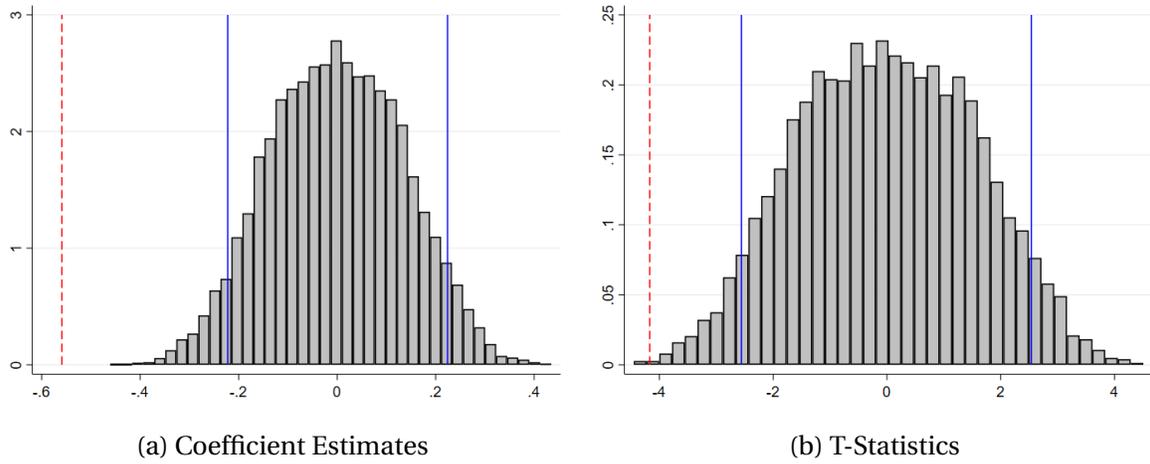
Figure A14: Distribution of Coefficient Estimates and T-Statistics from 10,000 Placebo Simulations

Notes: This graph displays the simulated coefficient estimates and t-statistics from a repeat of our baseline empirical specification but where the professional services exposure measures are replaced with randomly assigned exposure measures. The red lines display our estimated coefficients from t-statistics from the main analysis, while the blue lines display the 5th and 95 percentile confidence intervals.

Appendix B. Descriptive statistics and additional details

Table B1: 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
23rd Jun 2016	**Brexit Referendum**
13th Jul 2016	Cameron steps down, Theresa May becomes Prime Minister
29th Mar 2017	**Invocation of Article 50**
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'
12th Jul 2018	**UK Government publishes its White Paper ruling out mutual recognition as preferred option for financial services sector**
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 B2: Summary statistics

Variables	Mean	Median	Min.	Max.	Std Dev.	Dimensions
Job postings:						
Monthly postings	2,442	668	1	206,743	10,225	TTWA x month-year
Monthly postings - low skilled	775	265	1	48,718	2,449	TTWA x month-year
Monthly postings - high skilled	1,614	388	1	151,708	7,525	TTWA x month-year
Monthly postings - SOC1	254	56	0	28,761	1,342	TTWA x month-year
Monthly postings - SOC2	793	182	0	74,155	3,828	TTWA x month-year
Monthly postings - SOC3	416	94	0	40,616	1,944	TTWA x month-year
Monthly postings - SOC4	211	57	0	17,181	811	TTWA x month-year
Monthly postings - SOC5	150	54	0	8,505	428	TTWA x month-year
Monthly postings - SOC6	143	58	0	7,742	418	TTWA x month-year
Monthly postings - SOC7	223	66	0	16,004	762	TTWA x month-year
Monthly postings - SOC8	82	32	0	2,788	173	TTWA x month-year
Monthly postings - SOC9	115	45	0	6,916	313	TTWA x month-year
Exposure measures:						
Professional services exposure	0.127	0.0877	0.0323	0.548	0.0900	TTWA
Financial services exposure	0.0335	0.021	0.00814	0.287	0.0345	TTWA
Export tariff exposure	0.287	0.194	0.00778	4.20	0.405	TTWA
Import tariff exposure	0.582	0.395	0.0130	5.52	0.730	TTWA
Imported inputs tariff exposure	0.149	0.124	0.0203	0.722	0.102	TTWA
Controls:						
Xrate impact via exports	1.64	1.50	0.60	8.36	0.73	TTWA x month-year
EU national share	0.0465	0.0444	0.0182	0.144	0.0172	TTWA
EU8 national worker share	0.0297	0.0274	0.0121	0.0624	0.0106	TTWA
Uncertainty indices:						
Newspaper-based uncertainty index	4.33	4.12	2.16	7.15	1.45	month-year
Google-search-based uncertainty index	2.13	1.9	1.13	4.55	0.788	month-year
Brexit uncertainty index	44.3	39.2	34.8	58.3	7.79	month-year
Risk sentiment index	1.42	1.10	0.35	4.16	1.11	month-year
Sentiment index	0.68	0.55	-0.72	2.41	0.86	month-year

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 B3. The newspaper uncertainty index has been scaled by 100 so the mean of 4.33 represents 433 articles per month. *Sources*: Burning Glass Technologies, OECD STRI, WITS TRAINS, COMTRADE, UK ONS, Factiva, Bloom et al. (2019), Hassan et al. (2020).

Table B3: 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. *Sources*: ONS Standard Occupational Classification.

Table B4: 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. Sources: OECD STRI.

Table B5: Correlation between exposure measures

	services barrier exposure	tariff exposure	EU national share	EU8 national share
services barrier exposure	1			
tariff exposure	-0.047	1		
EU national share	0.1244	-0.0391	1	
EU8 national share	0.0201	0.0503	0.9390	1

Notes: This table displays the pairwise correlation coefficients between the exposure measures at the TTWA level.

Table B6: Professional services employment composition of most and least exposed TTWA

SIC Code (4-digit)	Percentage share of total TTWA employment	
	Edinburgh (highest exposure)	Girvan (lowest exposure)
6110	0.0	0.0
6120	0.0	0.0
6130	0.0	0.0
6190	0.4	0.0
6201	0.8	0.0
6202	1.1	0.0
6203	0.0	0.0
6209	1.2	0.0
6311	0.1	0.0
6312	0.1	0.0
6391	0.0	0.0
6399	0.0	0.0
6411	0.0	0.0
6419	5.3	0.4
6420	0.0	0.0
6430	0.1	0.0
6491	0.0	0.0
6492	0.0	0.0
6499	0.0	0.0
6511	1.6	0.0
6512	0.0	0.0
6520	0.0	0.0
6530	0.0	0.0
6910	1.3	0.2
6920	1.2	0.4
7111	0.4	0.0
7112	1.3	0.2
TOTAL :	15.0	1.2

Notes: Exposure here is defined as the employment weighted professional services exposure measure defined in section 3. *Sources*: ONS BRES.

Table B7: Baseline post-vote results weighted

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * service barrier exposure	-0.282**	-0.271**	-0.270**	-0.294**	-0.264**
	(0.112)	(0.108)	(0.107)	(0.133)	(0.126)
post vote * tariff exposure		0.0203	0.0330	0.0349	0.0329
		(0.0720)	(0.0832)	(0.0834)	(0.0830)
export REER			0.0861	0.0783	0.0888
			(0.206)	(0.213)	(0.211)
post vote * EU national share				0.110	
				(0.352)	
post vote * EU8 national share					-0.106
					(1.029)
Observations	12,780	12,780	12,780	12,780	12,780
Adjusted R-squared	0.995	0.995	0.995	0.995	0.995
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. Results are weighted by baseline (2015) annual postings at the TTWA level. *** p<0.01, ** p<0.05, * p<0.1.

Dep. Variable: log postings	(1)	(2)	(3)	(4)	(5)
			Panel (a)		
post vote * tariff exposure	-0.002	-0.010	-0.012	-0.010	-0.029
	(0.033)	(0.050)	(0.050)	(0.049)	(0.055)
				(1.451)	
post vote * service barrier exposure					-0.553***
					(0.127)
			Panel (b)		
post vote * tariff exposure	-0.021	-0.029	-0.034	-0.034	-0.040
	(0.035)	(0.051)	(0.050)	(0.049)	(0.054)
post vote * count NTBs	0.140	0.141	0.162	0.183	0.080
	(0.165)	(0.164)	(0.161)	(0.166)	(0.162)
				(1.425)	
post vote * service barrier exposure					-0.541***
					(0.134)
			Panel (c)		
post vote * tariff exposure	-0.012	-0.016	-0.017	-0.016	-0.030
	(0.037)	(0.052)	(0.052)	(0.051)	(0.055)
post vote * AVE NTBs	0.040	0.038	0.038	0.042	0.008
	(0.041)	(0.042)	(0.042)	(0.042)	(0.042)
				(1.446)	
post vote * service barrier exposure					-0.546***
					(0.135)
			Panel (d)		
post vote * (tariff + AVE NTB exposure)	0.024	0.026	0.026	0.030	-0.005
	(0.030)	(0.037)	(0.037)	(0.037)	(0.038)
				(1.455)	
post vote * service barrier exposure					-0.545***
					(0.138)

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 regressions control for the REER and immigration controls, repeating the specifications in the baseline results table. 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 B9: Production worker regressions

Dep variable: log prod. worker postings	(1)	(2)	(3)	(4)	(5)
post vote * service barrier exposure	-0.083	-0.094	-0.126	-0.175	-0.133
	(0.159)	(0.160)	(0.158)	(0.157)	(0.155)
post vote * tariff exposure		-0.050	-0.086**	-0.082**	-0.087**
		(0.035)	(0.041)	(0.040)	(0.040)
export REER			-0.235	-0.229	-0.208
			(0.158)	(0.151)	(0.148)
post vote * EU national share				2.085**	
				(0.905)	
post vote * EU8 national share					3.855**
					(1.506)
Observations	12,780	12,780	12,780	12,780	12,780
Adjusted R-squared	0.947	0.947	0.947	0.947	0.947
FE	TTWA YM	TTWA YM	TTWA YM	TTWA YM	TTWA YM
Cluster	TTWA YM	TTWA YM	TTWA YM	TTWA YM	TTWA YM

Notes: This table displays the results from the regressions of the log of monthly job postings for production workers 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 B10: 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***	-1.414***	-1.427***	-1.414***	-1.405***
	(0.322)	(0.323)	(0.327)	(0.319)	(0.329)
post vote * tariff exposure		0.015	0.007	0.007	0.008
		(0.032)	(0.048)	(0.048)	(0.048)
export REER			-0.054	-0.054	-0.059
			(0.130)	(0.130)	(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**	-0.662**	-0.681**	-0.697**	-0.680**
	(0.275)	(0.274)	(0.278)	(0.264)	(0.270)
post vote * tariff exposure		-0.014	-0.026	-0.026	-0.026
		(0.037)	(0.054)	(0.054)	(0.055)
export REER			-0.076	-0.075	-0.076
			(0.139)	(0.139)	(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 B11: 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***	-1.537***	-1.225***
	(0.327)	(0.376)	(0.332)
post vote * tariff exposure	-0.0372	0.0693	-0.0210
	(0.0442)	(0.0503)	(0.0489)
export REER	-0.137	0.146	-0.100
	(0.179)	(0.141)	(0.146)
post vote * EU national share	0.728	-0.979	0.152
	(0.906)	(0.990)	(1.031)
	5. Skilled Trades Occupations	7. Sales and Customer Service Occupations	4. Administrative and Secretarial Occupations
post vote * FS exposure	-0.942***	-0.775**	-0.294
	(0.316)	(0.317)	(0.272)
post vote * tariff exposure	-0.0394	-0.0461	-0.0503*
	(0.0340)	(0.0317)	(0.0296)
export REER	-0.283	-0.0686	-0.282**
	(0.192)	(0.154)	(0.118)
post vote * EU national share	2.469**	0.872	0.731
	(0.977)	(0.954)	(0.942)
	6. Caring, Leisure and Other Service Occupations	8. Process, Plant and Machine Operatives	9. Elementary Occupations
post vote * FS exposure	-0.271	-0.529	-0.398
	(0.321)	(0.343)	(0.367)
post vote * tariff exposure	0.0236	-0.0788**	0.0407
	(0.0379)	(0.0393)	(0.0740)
export REER	0.0917	-0.222	0.1000
	(0.121)	(0.150)	(0.185)
post vote * EU national share	-1.285	2.182**	0.682
	(0.968)	(0.898)	(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. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * service barrier exposure	-0.037	-0.027	-0.004	0.049	0.001
	(0.176)	(0.172)	(0.166)	(0.148)	(0.161)
post vote * tariff exposure		0.044	0.069*	0.065*	0.071*
		(0.040)	(0.032)	(0.030)	(0.033)
export REER			-0.800*	-0.783*	-0.757
			(0.405)	(0.425)	(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 B13: Baseline results with NUTS1 year-month linear time trends

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * service barrier exposure	-0.459***	-0.460***	-0.481***	-0.506***	-0.453***
	(0.145)	(0.145)	(0.147)	(0.140)	(0.141)
post vote * tariff exposure		-0.0132	-0.0354	-0.0343	-0.0405
		(0.0287)	(0.0479)	(0.0481)	(0.0496)
export REER			-0.149	-0.116	-0.0894
			(0.151)	(0.144)	(0.144)
post vote * EU national share				4.797***	
				(1.079)	
post vote * EU8 national share					7.070***
					(1.647)
Observations	12,780	12,780	12,780	12,780	12,780
Adjusted R-squared	0.985	0.985	0.985	0.985	0.985
TTWA FE	YES	YES	YES	YES	YES
Month-Year FE	YES	YES	YES	YES	YES
NUTS1 time trend	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 clustered by TTWA and YM. Results include linear NUTS1 time trends at the YM level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table B14: Baseline excluding London

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * service barrier exposure	-0.539***	-0.541***	-0.560***	-0.558***	-0.563***
	(0.135)	(0.135)	(0.137)	(0.134)	(0.139)
post vote * tariff exposure		-0.008	-0.029	-0.029	-0.029
		(0.033)	(0.055)	(0.055)	(0.054)
export REER			-0.136	-0.137	-0.143
			(0.146)	(0.146)	(0.146)
post vote * EU national share				-0.327	
				(1.002)	
post vote * EU8 national share					-0.929
					(1.426)
Observations	12,720	12,720	12,720	12,720	12,720
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 B15: Financial services results excluding London

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * financial services exposure	-1.416***	-1.416***	-1.449***	-1.450***	-1.450***
	(0.310)	(0.309)	(0.315)	(0.314)	(0.313)
post vote * tariff exposure		-0.00166	-0.0177	-0.0186	-0.0174
		(0.0325)	(0.0525)	(0.0523)	(0.0521)
export REER			-0.106	-0.109	-0.112
			(0.143)	(0.144)	(0.143)
post vote * EU national share				-0.462	
				(1.025)	
post vote * EU8 national share					-0.814
					(1.434)
Observations	12,720	12,720	12,720	12,720	12,720
Adjusted R-squared	0.983	0.983	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. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * service barrier exposure	-4.287**	-4.216**	-4.246**	-4.247**	-4.162**
	(1.972)	(1.974)	(1.988)	(1.959)	(1.933)
post vote * services emp sh * EU export sh	0.544*	0.534*	0.535*	0.536*	0.523*
	(0.284)	(0.285)	(0.286)	(0.283)	(0.279)
post vote * tariff exposure		-0.032	-0.031	-0.031	-0.030
		(0.060)	(0.062)	(0.062)	(0.062)
post vote * manu emp sh * EU export sh		0.001	0.000	0.000	0.000
		(0.002)	(0.004)	(0.004)	(0.004)
export REER			-0.108	-0.108	-0.117
			(0.233)	(0.234)	(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 B17: Shift-share: Incomplete shares analysis

	(1)	(2)	(3)
Mean	0.000086	0.0015	0
Standard deviation	0.00062	0.0022	0.0019
Interquartile range	0	0.0013	0.0015
Specification			
Excluding service industries		Y	Y
Residualizing on period FE			Y
Effective sample size (1/HHI of s_nt weights)			
Across industries and periods	67	509	509
Across SIC2 groups	1.1	5.1	5.1
Largest s_nt weight			
Across industries and periods	0.016	0.0035	0.0035
Across SIC2 groups	0.94	0.25	0.25
Observation counts			
No. of industry-period shocks	1620	1560	1560
No. of industries	27	26	26
No. of SIC2 groups	8	7	7

Notes: This table summarizes the distribution of professional services exposure shocks g_{nt} across industries n and periods t, recreating Table 1 from Borusyak et al. (2022) (see this paper for more background). Shocks are measured as the export weighted STRI gap between EEA and MFN services barriers across destinations and sub-sectors. All statistics are weighted by the average industry exposure shares s_{nt}; shares are measured from initial 2015 professional services employment. Column 1 includes the non-professional services industry aggregate in each period with a shock of zero, while Columns 2 and 3 restrict the sample to professional services industries. Column 3 residualizes professional services shocks on period indicators. We report the effective sample size (the inverse renormalized Herfindahl index of the s_{nt} weights) with and without the non-prof. services industry, at the industry-by-period level and at the level of SIC2 groups (aggregated across periods), along with the largest s_{nt}.

Table B18: Shift-share: Balance analysis

Balance variable	Coef.		SE
Panel A: Industry-level balance			
Start-of-period capital stock	125,691*		(64,068)
Start-of-period wage	13,195		(41,301)
Start-of-period % workforce with degree or higher	-79.76**		(36.20)
No. of industry-periods		1,621	
Panel B: Regional balance			
Start-of-period % of NVQ4+ educated population	-0.851		(5.257)
Start-of-period % of foreign-born population	-2.984		(5.400)
Start-of-period % of employment among women	-3.134		(4.120)
Start-of-period % of employment in routine occupations	0.0740		(0.084)
Start-of-period % of employment in medium or large enterprises	-0.463		(0.407)
Prof. services employment growth, 2012-2014	21.083**		(8.447)
No. of region-periods		12,780	

Notes: Panel A reports coefficients from regressions of industry-level covariates on professional services exposure weighted by regional employment shares. Panel B reports coefficients from regressions of TTWA-level covariates on the professional services shift-share exposure. SIC 4-digit clustered exposure-robust standard errors are reported in parentheses and obtained from equivalent industry-level regressions based on Borusyak et al. (2022). *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table B19: Shift-share: Estimates

	(1)	(2)	(3)	(4)
Post vote * prof services exposure	-0.538***	-0.736***	-0.356***	-0.650***
	(0.068)	(0.082)	(0.155)	(0.057)
Regional controls		Y		Y
Industry controls			Y	Y
Clustered	SIC 2	SIC 2	SIC 2	SIC 2
No. of region-periods	12,780	12,780	12,780	12,780
No. of industry-periods	1,620	1,620	1,560	1,560

Notes: Exposure-robust standard errors (reported in parentheses) are obtained from equivalent industry-level regressions, as described in the text, allowing for clustering of shocks at the level of two-digit SIC codes.

Table B20: Output-weighted services barrier and tariff exposure

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
	Panel a) Output-weighted services barrier only				
post vote * service barrier exposure	-50.07***	-50.71***	-51.31***	-53.53***	-51.09***
	(17.27)	(17.35)	(17.35)	(16.55)	(16.58)
post vote * tariff exposure		-0.0147	-0.0288	-0.0286	-0.0287
		(0.0341)	(0.0534)	(0.0535)	(0.0534)
export REER			-0.0916	-0.0910	-0.0922
			(0.136)	(0.135)	(0.135)
post vote * EU national share				0.368	
				(0.815)	
post vote * EU8 national share					-0.107
					(1.278)
Observations	12,780	12,780	12,780	12,780	12,780
Adjusted R-squared	0.984	0.984	0.984	0.984	0.984
	Panel b) Output-weighted services barrier and tariffs				
post vote * service barrier exposure	-50.07***	-49.98***	-50.08***	-52.40***	-49.79***
	(17.27)	(17.52)	(17.51)	(16.73)	(16.73)
post vote * tariff exposure		1.141	-0.259	-0.819	0.0109
		(20.23)	(21.67)	(22.20)	(21.86)
export REER			-0.0288	-0.0296	-0.0294
			(0.0759)	(0.0758)	(0.0759)
post vote * EU national share				0.375	
				(0.822)	
post vote * EU8 national share					-0.134
					(1.296)
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	TTWA YM	TTWA YM	TTWA YM	TTWA YM	TTWA YM
Month-Year FE	TTWA YM	TTWA YM	TTWA YM	TTWA YM	TTWA YM

Notes: This table displays the results from the regressions of the log of monthly job postings in each TTWA on the trade barrier exposure measures at the TTWA level interacted with the post vote dummy variable, with and without controls. In panel a) we replace the services barrier measure used in the baseline regressions with a version that weights barriers by sectoral output instead of employment. In panel b) we replace both the services barrier measure and tariff measures used in the baseline regressions with versions that weight barriers by sectoral output rather than employment. 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 B21: 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***		-0.554***		-0.539***		-0.525***
		(0.127)		(0.135)		(0.127)		(0.125)
post vote * tariff exposure	9.830	1.122	4.416	-2.999	10.34	1.237	0.000	0.000
	(18.09)	(21.27)	(7.898)	(8.413)	(19.11)	(22.41)	(0.000)	(0.000)
export REER		-0.069		-0.082		-0.068		-0.032
		(0.084)		(0.081)		(0.084)		(0.075)
post vote * EU national share		-0.248		-0.220		-0.248		-0.277
		(0.866)		(0.871)		(0.866)		(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 B22: Goods non-tariff barriers

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * service barrier exposure	-0.538***	-0.531***	-0.550***	-0.541***	-0.544***
	(0.132)	(0.139)	(0.141)	(0.134)	(0.138)
post vote * tariff exposure		-0.017	-0.038	-0.040	-0.042
		(0.036)	(0.055)	(0.054)	(0.054)
post vote * goods NTMs		0.069	0.069	0.080	0.104
		(0.166)	(0.165)	(0.162)	(0.166)
export REER			-0.135	-0.136	-0.143
			(0.144)	(0.144)	(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 B23: Specific Tariffs and Quotas

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * service barrier exposure	-0.509***	-0.510***	-0.605***	-0.561***	-0.598***
	(0.124)	(0.124)	(0.135)	(0.127)	(0.132)
post vote * tariff exposure	-0.070	-0.070	-0.029	-0.080	-0.027
	(0.079)	(0.079)	(0.053)	(0.079)	(0.053)
post vote * ad val tariff exposure	0.126				
	(0.145)				
post vote * quota exposure		0.125		0.155	
		(0.147)		(0.165)	
post vote * specific tariff exposure			-1.458	-1.713	
			(1.151)	(1.143)	
post vote * quota or specific tariff exposure					-2.504
					(1.724)
export REER	-0.175	-0.175	-0.130	-0.178	-0.123
	(0.170)	(0.171)	(0.146)	(0.170)	(0.145)
post vote * EU national share	-0.305	-0.300	-0.100	-0.112	-0.168
	(0.869)	(0.868)	(0.852)	(0.852)	(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 B24: Import protection and imported inputs

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * import protection tariff exposure	-0.008		-0.027		
	(0.017)		(0.041)		
post vote * intermediate import tariff exposure		-0.024	-0.010		
		(0.124)	(0.256)		
post vote * service import barrier exposure				-2.252***	-1.389**
				(0.562)	(0.579)
post vote * service barrier exposure			-0.553***		-0.271*
			(0.139)		(0.157)
post vote * export tariff exposure			0.017		-0.0330
			(0.085)		(0.0556)
export REER			-0.142		-0.141
			(0.180)		(0.146)
post vote * EU8 national share			-0.733		-0.703
			(1.325)		(1.361)
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. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table B25: Spatial clustering

Dep. variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * service barrier exposure	-0.538***	-0.540***	-0.559***	-0.553***	-0.557***
	(0.097)	(0.098)	(0.101)	(0.098)	(0.100)
post vote * tariff exposure		-0.008	-0.029	-0.029	-0.029
		(0.026)	(0.039)	(0.039)	(0.038)
export REER			-0.135	-0.136	-0.141
			(0.120)	(0.120)	(0.121)
post vote * EU national share				-0.267	
				(0.569)	
post vote * EU8 national share					-0.885
					(0.915)
Observations	12,780	12,780	12,780	12,780	12,780
TTWA FE	YES	YES	YES	YES	YES
Cluster	Spatial	Spatial	Spatial	Spatial	Spatial

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 clustered using the HAC spatial approach (with a 200km distance cutoff). *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table B26: Baseline results with TTWA clustering

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * service barrier exposure	-0.538***	-0.540***	-0.559***	-0.553***	-0.557***
	(0.110)	(0.111)	(0.115)	(0.113)	(0.114)
post vote * tariff exposure		-0.00810	-0.0288	-0.0293	-0.0285
		(0.0341)	(0.0552)	(0.0554)	(0.0547)
export REER			-0.135	-0.136	-0.141
			(0.149)	(0.150)	(0.150)
post vote * EU national share				-0.267	
				(0.607)	
post vote * EU8 national share					-0.885
					(1.009)
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 clustered at the TTWA level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Appendix C. Further definitions and details of robustness checks

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.

To provide a further illustration of the index, we compare Luxembourg and Poland's STRI 'gap' for legal services. Figure C1 provides the breakdown of the indices for these two countries. Both Luxembourg and Poland have very high MFN STRIs and moderate Intra-EEA STRIs, resulting in a very high gap between the two. For both countries the high MFN STRI results from the high score from the number of restrictions on foreign entry. In terms of number of restrictions in panel b) these two countries have very similar breakdowns between restrictions on foreign entry and restrictions to movement of people.

The OECD's Index Simulator tool provides a further breakdown of the measures underpinning the indices.[63] Figure C2 provides an example of some of the MFN STRI measures for the legal sector in Luxembourg, with a comparison for the Intra-EEA STRI. For Luxembourg the restrictions on foreign entry include a ban on the acquisition of equity by foreign licensed lawyers and localisation requirements for professional liability insurance, while the restrictions on the movement of people include labor market tests for intra-corporate transferees and nationality or citizenship requirements for licensee to practice.

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[63]https://sim.oecd.org/Simulator.ashx?lang=Ends=INTRAEEASTRId1c=pslegd2c=luxd2cc=intraeea$_l ux$

(a) MFN and Intra-EEA STRI
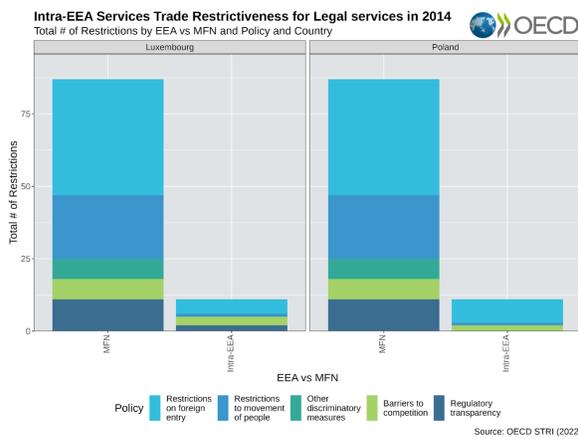
(b) Number of restrictions
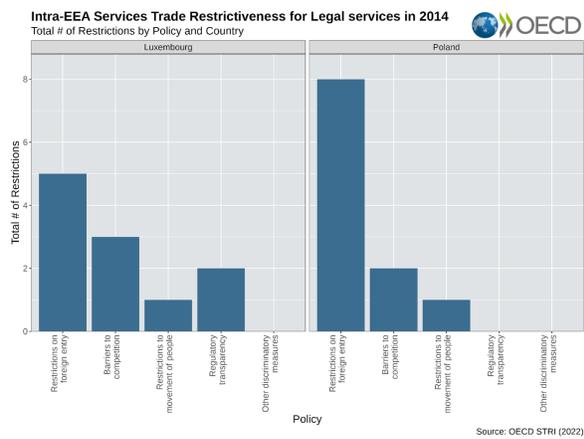
(c) Policy types

Figure C1: Poland and Luxembourg legal sector examples

Notes: This figure displays examples of the STRI breakdown for Poland and Luxembourg in 2014. *Sources*: OECD STRI.

Legal services measures	Answers	Scores	Values	Luxembourg intraEEA
psleg.1 Restrictions on foreign entry		50	0.68	0.068
1.1.1 Foreign equity restrictions: maximum foreign equity share allowed (%) (domestic law)	Exactly 100%	4	0.054	0
1.1.1 Foreign equity restrictions: maximum foreign equity share allowed (%) (international law)	Exactly 100%	4	0.054	0
1.1.4 Equity restrictions applying to not licensed individuals or firms (100, <50, >50, 0) (domestic law)	Zero	3	0.041	0.014
1.1.4 Equity restrictions applying to not licensed individuals or firms (100, <50, >50, 0) (international law)	Zero	3	0.041	0.014
1.2.1 Legal form: only joint ventures are allowed (domestic law)	Yes / ●No	1	0.014	0
1.2.11 Legal form: sole proprietorship is prohibited (domestic law)	Yes / ●No/na	1	0.014	0
1.2.21 Legal form: corporation is prohibited (domestic law)	Yes / ●No/na	1	0.014	0
1.2.31 Legal form: partnership is prohibited (domestic law)	Yes / ●No/na	1	0.014	0
1.2.8 Legal form: other restrictions (domestic law)	Yes / ●No	1	0.014	0
1.2.51 Commercial association is prohibited between locally and not locally licensed lawyers	Yes / ●No/na	1	0.014	0
1.2.41 Commercial association is prohibited between lawyers and other professionals	●Yes / No/na	1	0.014	0.014
1.2.61 Prohibitions on hiring locally-licensed lawyers	Yes / ●No/na	1	0.014	0
1.4.1 Board of directors: majority must be nationals (domestic law)	Yes / ●No	1	0.014	0
1.4.2 Board of directors: majority must be residents (domestic law)	Yes / ●No	1	0.014	0
1.4.21 Board of directors: majority must be licensed professionals (domestic law)	Yes / ●No/na	1	0.014	0
1.4.21 Board of directors: majority must be licensed professionals (international law)	Yes / ●No/na	1	0.014	0
1.4.3 Board of directors: at least one must be national (domestic law)	●Yes / No	1	0.014	0
1.4.4 Board of directors: at least one must be resident (domestic law)	Yes / ●No	1	0.014	0
1.4.41 Board of directors: at least one must be a licensed professional (domestic law)	●Yes / No/na	1	0.014	0.014
1.4.41 Board of directors: at least one must be a licensed professional (international law)	●Yes / No/na	1	0.014	0.014
1.4.5 Managers must be national (domestic law)	Yes / ●No	1	0.014	0
1.4.6 Managers must be resident (domestic law)	Yes / ●No	1	0.014	0
1.4.7 Manager must be a licensed professional (domestic law)	Yes / ●No/na	1	0.014	0
1.4.7 Manager must be a licensed professional (international law)	Yes / ●No/na	1	0.014	0
1.5.1 Screening explicitly considers economic interests	Yes / ●No	1	0.014	0

Figure C2: Example of Luxembourg legal measures for MFN STRI

Notes: This figure displays examples of the measures for the Luxembourg legal sector STRI for the category of 'restriction on entry' using the OECD's STRI simulator. *Sources*: OECD.

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.

Brexit Uncertainty Index (BUI)

The Decision Makers Panel (DMP) is a panel survey of 8,000 UK firms, with around 3,000 responding in any given month.[64] 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.

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

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[64]https://decisionmakerpanel.co.uk

constructed in Hassan et al. (2020) for UK headquartered firms.[65] The Brexit Risk index is a quarterly measure with most recent data reaching up until Q1 2019.

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 C1 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.[66] Our data comes from Factiva, a news aggregator, and covers the period 2015-2019.

Table C1: 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.

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,

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[65]More details about this measure can be found in Hassan et al. (2020) or on the authors' data website firmlevelrisk.com

[66]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.

through directly observing what people are searching for. Google Trends provides public information on the Google searches conducted within a given region over time.[67] We use searches for the same terms as for the newspaper measure, but exclude the uncertainty-related terms.[68]

Comparing uncertainty measures

Figure C3 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.

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[67]https://trends.google.com/trends, our index is a self-referential, relative measure of searches rather than an absolute number.

[68]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.
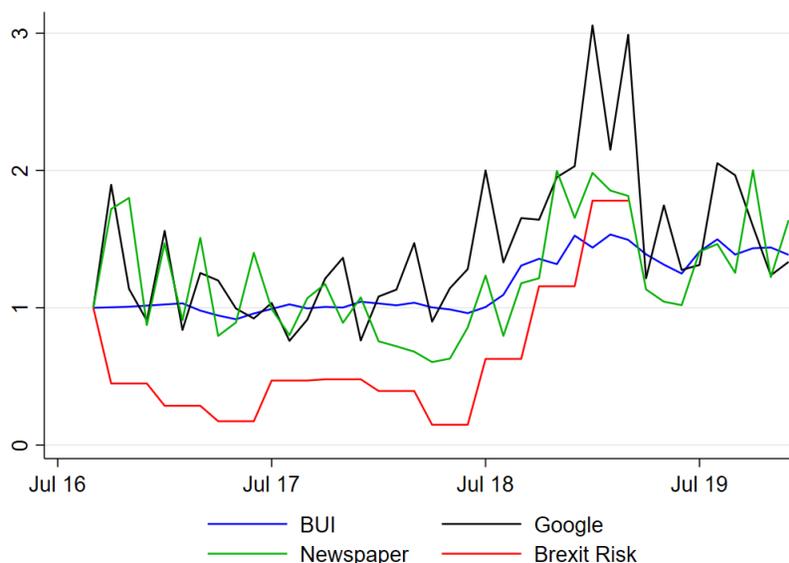
Figure C3: Brexit trade policy uncertainty measures

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. *Sources*: BUI, Bloom et al. (2019); Brexit Risk, Hassan et al. (2020); Google trends; Factiva.

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.

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).[69] 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.

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[69]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.
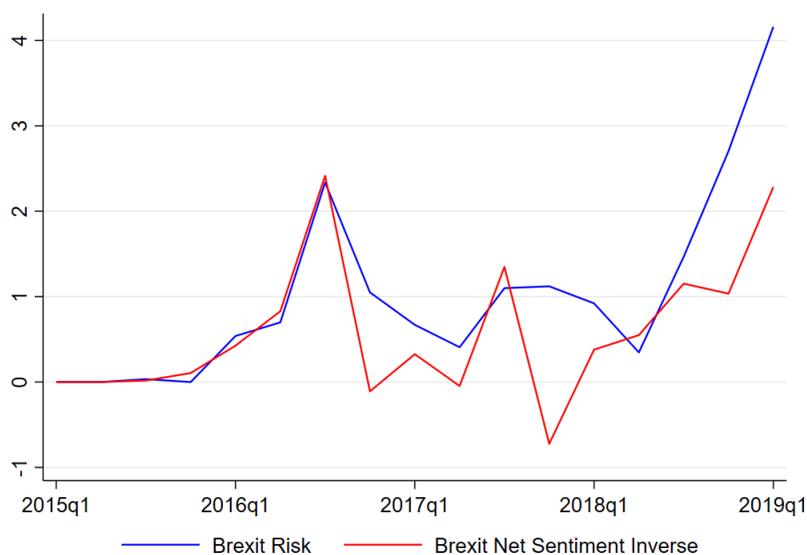
Figure C4: Brexit Risk and Sentiment Indices

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 sentient when discussing Brexit. *Sources*: Hassan et al. (2020)

Figure C4 displays the average of this index for UK headquartered firms, compared with the Brexit Risk index.[70] 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.

In Table C2, 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.

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[70]We take the inverse of the sentiment index such that positive values reflect more negative sentiment about Brexit.

Table C2: Brexit Risk and Sentiment Indices Compared

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)	(6)
Brexit risk*service barrier exposure	-0.141***	-0.172***			-0.113	-0.146*
	(0.0498)	(0.0508)			(0.0697)	(0.0716)
Brexit risk *tariff exposure	0.00548	0.0108			0.0166	0.0222*
	(0.00954)	(0.00975)			(0.0123)	(0.0129)
Brexit risk*EU national share	-1.585***				-1.647***	
	(0.281)				(0.366)	
Brexit risk*EU8 national share		-2.394***				-2.454***
		(0.414)				(0.560)
Brexit sentiment*service barrier exposure			-0.156*	-0.183*	-0.0499	-0.0476
			(0.0872)	(0.0956)	(0.110)	(0.118)
Brexit sentiment *tariff exposure			-0.00456	0.000298	-0.0199	-0.0203*
			(0.00959)	(0.00862)	(0.0129)	(0.0117)
Brexit sentiment*EU national share			-1.424**		0.109	
			(0.538)		(0.514)	
Brexit sentiment*EU8 national share				-2.180**		0.106
				(0.860)		(0.847)
export REER	0.124	0.148	0.175	0.191	0.149	0.174
	(0.404)	(0.411)	(0.419)	(0.420)	(0.393)	(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. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Import barriers

Although most of the discussion around trade barriers centered around the potential impact on UK exports, there was also some uncertainty concerning possible UK barriers on imports from the EU under a no deal scenario. As discussed in the text, while the threat of barriers on exports under a no deal scenario was unambiguous given MFN export barriers were set by EU members, the threat of import barriers was somewhat more ambiguous as the UK had control over the tariffs or regulations it would impose after leaving the EU. The UK had also, at times during the negotiation period, suggested it may take the position of unilaterally liberalizing import tariffs. Nevertheless, there remained some risk and we further evaluate whether the threat of these tariffs had any impact on the posting of job adverts. We construct the following measures:

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:

$$impprotection_{j^{manu},2014} = \frac{Imports_{j^{manu},2014}}{L_{j^{manu},2015}} \times avgMFNtariff_{j^{manu},2014}^{(Imp)} \tag{11}$$

where $avgMFNtariff_{j^{manu},2014}^{(Imp)}$ 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 $Imports_{j^{manu},2014}$ is UK imports from the EU in 2014. The TTWA level exposure is then:

$$impprotection_r = \sum_{j^{manu} \in r} emplshare_{j^{manu}r,2015} \times impprotection_{j^{manu},2014} \tag{12}$$

where $emplshare_{j^{manu}r,2015}$ is industry j^{manu}'s share of TTWA r employment.

Exposure to increased cost of imported goods 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.[71] Specifically, the measure is calculated as follows:

$$intinputsthreat_{k,2014} = \frac{1}{L_k} \sum_{j^{manu}} S_{k,j^{manu}} \sum_{p \in j^{manu}} Imports_p \times MFNtariff_{p,2014} \tag{13}$$

$$intinputsthreat_r = \sum_{k \in r} emplshare_{rk,2015} \times intinputsthreat_{k,2014} \tag{14}$$

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.

Exposure to reduced competition through services import barriers

One possibility firms may have considered was that the UK would implement barriers on imports from the EEA in line with its MFN services trade barriers. We measure this barrier threat using the UK's MFN STRI for each sector. We construct an analogous measure to the export 'STRI gap' measure for imports, taking the difference between the MFN STRI and Intra-EEA STRI for the UK. In contrast to for exports, where the 'threat' of barriers varied across EEA export destinations, for imports this threat was the same vis a vis all EEA countries.

$$impprotection_{j^{serv},2014} = \frac{Imports}{j^{serv},2015 L_{j^{serv},2015} \times STRIgap^{(Imp)}_{j^{serv},2014}} \tag{15}$$

where $STRIgap^{(Imp)}_{j^{serv},2014}$ is the difference between the MFN and intra-EEA STRI for sector j^{serv}, $L_{j^{serv},2015}$ is the national employment in sector j^{serv} (4-digit ISIC), and $Imports_{j^{serv},2015}$ is UK imports from the EU in 2015. The TTWA level exposure is then:

$$impprotection_r = \sum_{j^{serv} \in r} emplshare_{j^{serv}r,2015} \times impprotection_{j^{serv},2014} \tag{16}$$

where $emplshare_{j^{serv}r,2015}$ is industry j^{serv}'s share of TTWA r employment.

Services import barriers could both provide protection for import-competing industries and raise costs of imported inputs. For services, however, it is not possible to construct an imported services input exposure measure given the limited granularity of UK input-output tables for services.

Impacts on unemployment

Figure C5 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

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[71]UK input-output tables: www.ons.gov.uk/economy/nationalaccounts/supplyandusetables/datasets/ukinputoutputanalyticaltablesdetailed

collects data on a range of social and socio-economic variables at local levels, and is described in Section 3.[72] 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.
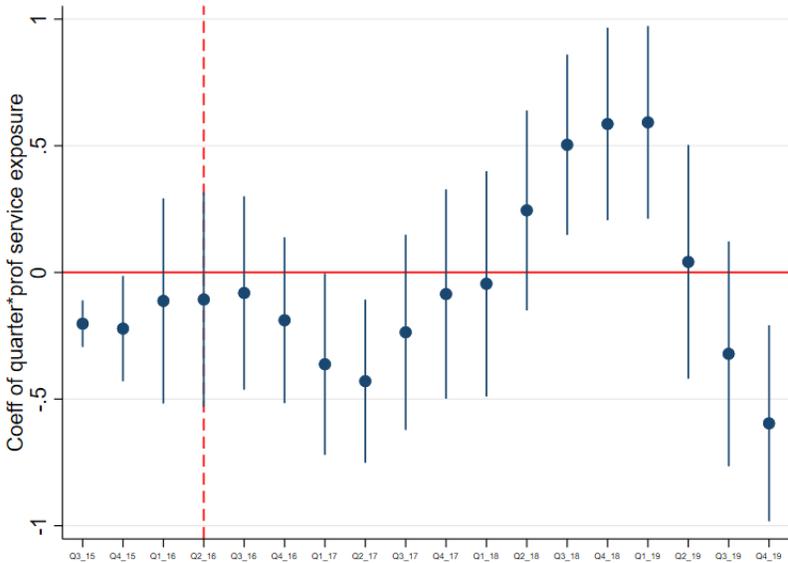
Figure C5: Impact on unemployment

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. *Sources*: UK ONS.
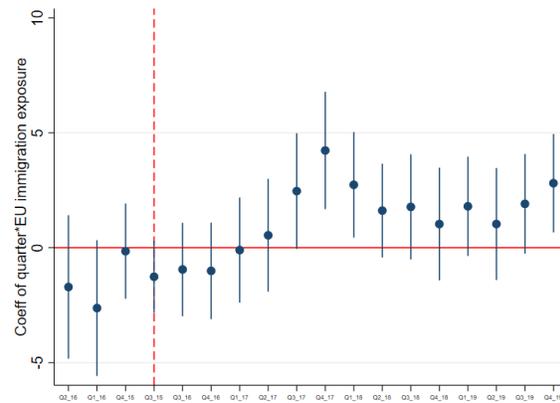
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[72]The unemployment rate is calculated by dividing the unemployment level for those aged from 16 to 64 by the economically active population for that age group.
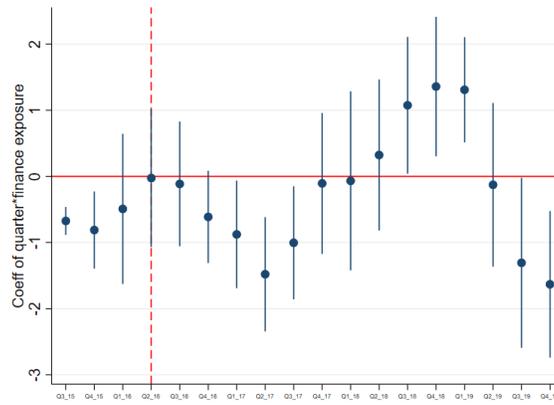
(a) Financial services exposure
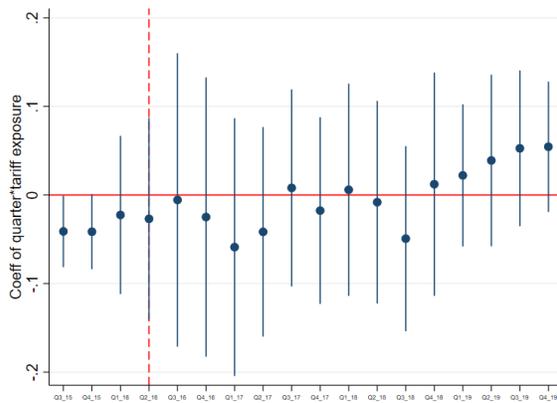
(b) Tariff exposure

(c) EU share

Figure C6: Impact on unemployment

Notes: These graphs show the coefficients from the regression of the log of quarterly unemployment rates at the TTWA level 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.

The results for financial services, displayed in Figure C6 above are similar. There is 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.

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

changes, displayed in Figure D3 in the Online Appendix, does not suggest any decline in people changing jobs, but in fact a slight increase. Figure D1 in the Online Appendix 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.

Appendix 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, particularly 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.[73]
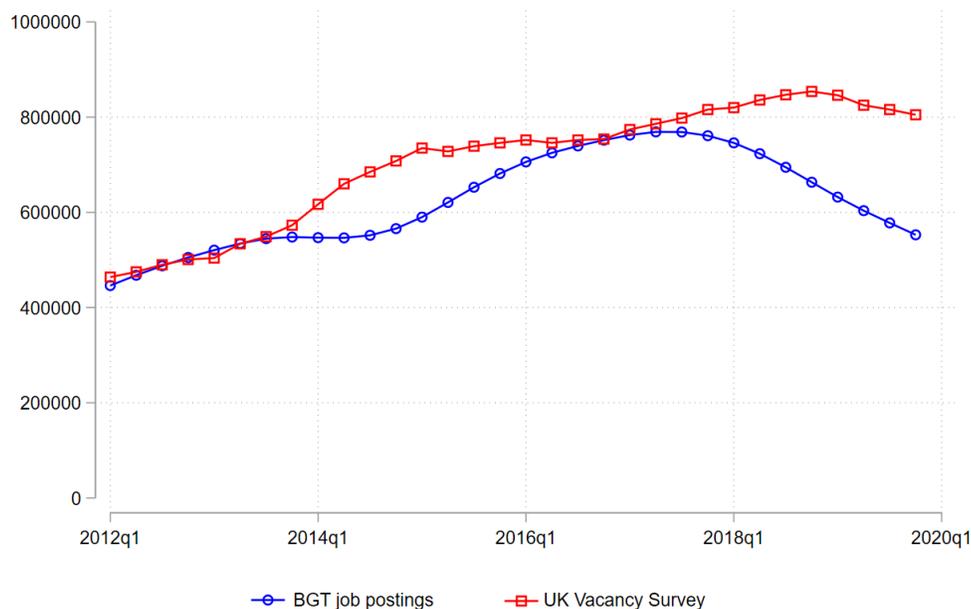
The total sample is approximately 6,000 businesses per month, with approximately 1,300 large businesses included every month and the remaining 4,700 consisting of smaller enterprises randomly sampled on a quarterly basis. The ONS then constructs total estimates for the UK by weighting the data using 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.[74]

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.

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[73]A summary can be found here: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/methodologies/vacancysurveyqmi

[74]Results are seasonally adjusted in X-12 ARIMA using a multiplicative model.

Figure D1: 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. *Sources*: UK ONS.

To compare figures from the two sources, we deseasonalise the BGT data and take quarterly averages of the total sum of all postings. Figure D1 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 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 D2 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
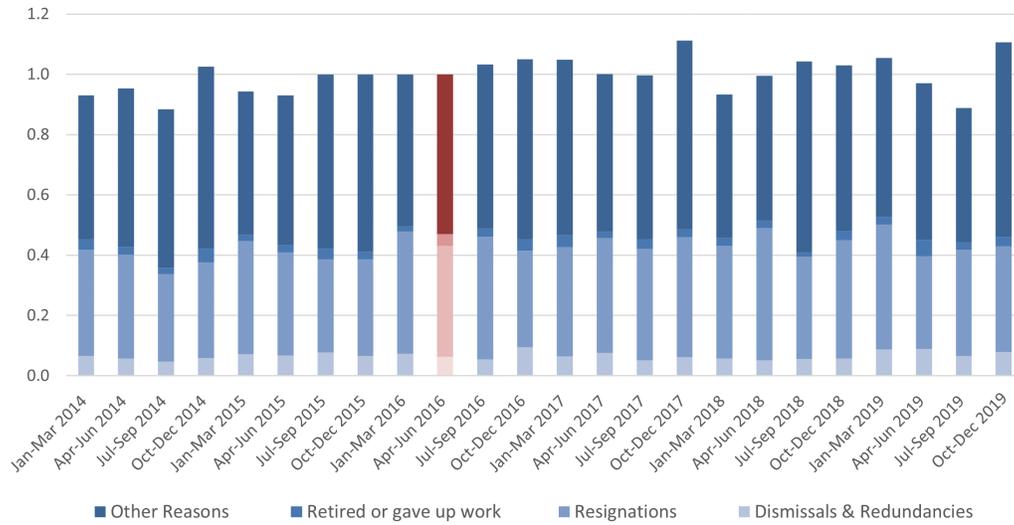
periods of total employment, as well as being normalised relative the the relevant quarter in the year preceding the referendum in June 2016. This graph shows that gross inflows and gross outflows show a very slight declining trend over the time frame, implying a slight decrease in the dynamism of the workforce, but displays no major change.
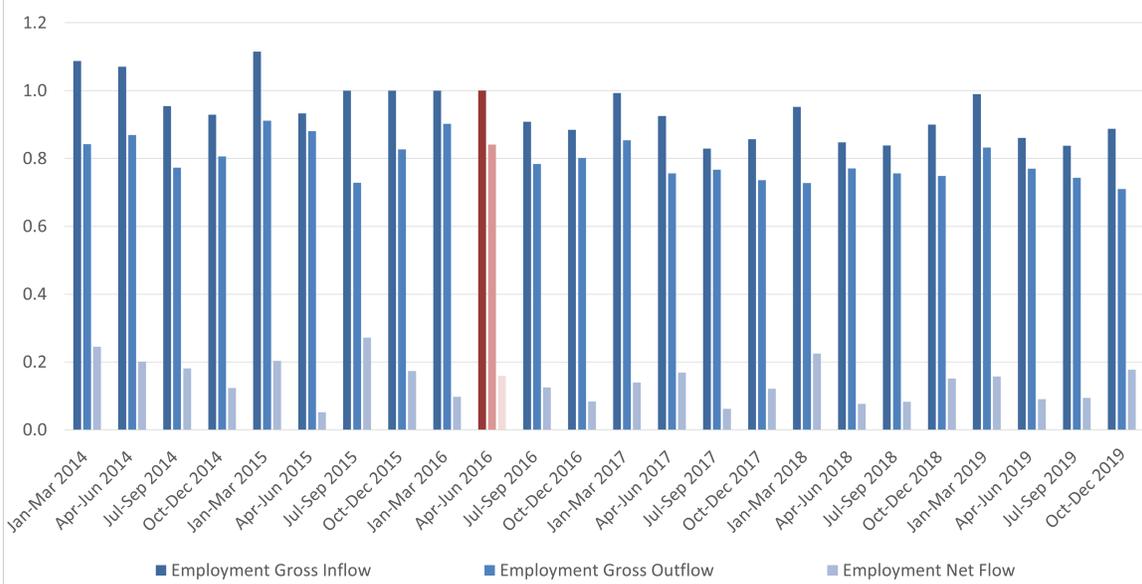
Figure D2: Gross and net employment inflows and outflows as a percentage of employment, normalised relative to pre-referendum period

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

Figure D3 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 D3: 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 the the relevant quarter in the year preceding the referendum in June 2016. *Sources*: UK ONS.