Essays on Foreign Direct Investment and International Trade



Benjamin Kett

St Anne's College

University of Oxford

A thesis submitted for the degree of

Doctor of Philosophy in Economics

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This thesis consists of three standalone chapters split between two main topics that speak to the effects of using unilateral, national policies in place of pursuing international cooperation. The first topic focuses on the recent move towards increased trade barriers and their effects on labour demand, and the second addresses the utilisation of tax policy to attract internationally mobile capital. Chapters 1 and 2 cover the first topic, using high frequency data on the near universe of job adverts posted online in the United Kingdom and United States to investigate the relationship between trade barriers and labour demand. Chapter 1 specifically studies the impact of the Brexit referendum on labour demand, with the emphasis placed on potential future trade barriers between the UK and European Union. The main results show that commuting zones that were more exposed to potential barriers on professional services exports saw a differential decline in online job adverts in the period after the referendum, particularly after the middle of 2018, and in months when there was heightened uncertainty about trade policy. No such effect is found for commuting zones than were more exposed to future tariff barriers of goods. Chapter 2 investigates the impact of the 2018 tariff increases on US labour demand, in this case focusing on the actual tariffs that were applied during this period rather than expectations about the future. The analysis finds that commuting zones that were more exposed to tariffs on imported inputs, as well as those more exposed to retaliatory tariffs, saw a differential decline in online job adverts in 2018. No equivalent positive effect was found for tariffs on imports competing with US production. [The text originally presented here cannot be made freely available via ORA because of copyright.]

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Introduction

The decrease in transport costs and trade barriers, improvement in information and communication technologies, and reduction in capital controls since 1970 have contributed to a level of global integration today that would have been hard to imagine 50 years ago.[1] However, recent years have shown an increased tension between international cooperation and the pursuit of national policy agendas.

The Great Recession, and the associated rise in unemployment, increased pressure on countries to both protect and create jobs at home. The policy response in affected countries has frequently turned towards nationalist solutions, albeit to a lesser degree than following the Great Depression (O'Rourke (2017), Irwin (2020)). In terms of new trade barriers, perhaps the two highest profile examples can be found in the Brexit referendum of 2016 and the US trade war of 2018. The risk to the rule-based system of international trade was brought to a head when the World Trade Organisation's Appellate body ceased to function due to the expiry, and non-replacement, of two of the remaining three judges. International cooperation on taxation to avoid a 'race to the bottom' in corporate tax rates is continuing to prove challenging, despite the work of the Organisation for Economic Cooperation and Development (OECD) and G20 on Base Erosion and Profit Shifting (BEPS).

This thesis concentrates on two key topics that speak to the usage of unilateral, national policies over international cooperation: the recent move towards increased trade barriers and their effects on labour demand; and the usage of national tax policy to attract internationally mobile capital. By contributing to a better understanding of the impact of these policies, I hope it may become clearer where

[1] See Baldwin (2016) for a discussion of the drivers of modern globalisation.

true tension lies and where the objectives of national policy and international co-operation may instead align.

This thesis consists of three standalone chapters split between these two main topics: Chapters 1 and 2 speak to the first topic, and Chapter 3 relates to the second. Specifically, Chapter 1 studies the impact of the Brexit referendum on labour demand in the UK between January 2015 and December 2019, with the emphasis placed on the role of potential future trade barriers between the UK and EU. Chapter 2 investigates the impact of the 2018 tariff increases on US labour demand between January 2017 and December 2018, in this case focusing on the actual tariffs that were applied during this period rather than expectations about the future. Finally, Chapter 3 analyses the impact of corporate tax rates and tax holidays on inward greenfield Foreign Direct Investment (FDI) using a new global panel dataset on national tax policies, covering 158 countries and 22 sectors between 2009 and 2015.

The first topic looks at the relationship between trade policy and local labour demand, as proxied by measures of online job postings.

Recent decades have seen a huge increase in trade integration globally, with trade as a percentage of world GDP rising from 27 percent in 1970 to 59 percent in 2018, and the number of preferential trade agreements rising from around 40 prior to the start of the Uruguay round of trade negotiations (1986), to around 730 today.[2] This has been accompanied by significant reductions in tariff rates, from a world average of 6.4 percent at the founding of the WTO in 1995 to 2.6 percent in 2017.[3]

There is significant evidence that increased trade can promote economic growth (Frankel and Romer (1999), Bernhofen and Brown (2005), Feyrer (2009), Feyrer (2019)). In the EU context, Mayer et al. (2019) estimate that membership of the EU has resulted in average trade-related welfare gains of 4.4 percent, and Dhingra et al. (2017) estimate a decline in UK average income per capita of 6.3-9.4 percent

[2]Trade as a percentage of GDP sourced from the World Bank : https://data.worldbank.org/indicator/NE.TRD.GNFS.ZS. Number of preferential trade agreements sourced from UNCTAD (https://unctad.org/en/PublicationsLibrary/ditctab2015d2_en.pdf) and the TRade ENvironment Database (http://www.chaire-epi.ulaval.ca/en/trend).

[3]Trade weighted mean applied tariffs sourced from the World Bank: https://data.worldbank.org/indicator/TM.TAX.MRCH.WM.AR.ZS.

if the UK moved towards trading with the EU on WTO terms. China has followed a strategy of export-led growth with average growth rates of above 6 percent since 1991, and an increase in trade as a percentage of GDP from 24.3 percent in 1990 to a maximum of 64.5 percent in 2006.[4]

Alongside the potential for aggregate growth, trade theory has long discussed the potential uneven benefits of increasing free trade. Empirical trade research has more recently documented some of these effects (see Topalova (2010), Edmonds et al. (2010), Autor et al. (2016), and Autor (2018)). Autor et al. (2013), for example, show that rising imports from China caused higher unemployment, lower labour force participation, and reduced wages in US local labour markets that contain import competing manufacturing industries. There is evidence that these uneven effects, along with the Great Recession, have contributed to the recent rise of nationalist trade policies and the associated backlash against globalisation. Autor et al. (2020) find evidence that US commuting zones more heavily impacted by trade saw a political shift to the right, with an increased market share for the cable news channel Fox News and a relative rise in the likelihood of electing a Republican to congress.

The first two chapters of my thesis add to this growing literature by focusing on the relationship between trade barriers and local labour demand. Providing jobs for citizens has been a key driving force behind both the Brexit vote and the US tariff changes. Key Brexit campaigner and Member of Parliament Ian Duncan Smith explained his view that 'Brits on low pay – and those out of work – are forced to compete with millions of people from abroad for jobs', and ending free movement of people was one of Prime Minister Theresa May's 'red lines' in negotiations with the EU. President Trump has expressed a clear focus on US jobs and their link with trade policy, as evidenced by statements during his inaugural address such as 'One by one, the factories shuttered and left our shores, with not even a thought about the millions upon millions of American workers left behind' and promising that 'we will bring back our jobs.'[5] It is therefore natural to focus on effects on labour demand as a primary outcome of both cases of introducing trade restrictions. Fur-

[4]Trade is here defined as the sum of the value of imports and exports.

[5]https://www.whitehouse.gov/briefings-statements/the-inaugural-address

thermore, previous work has shown that the uneven impacts of trade integration have had a clear geographical dimension, including on local labour markets.

The job postings data used in Chapters 1 and 2 has several key features which make it well suited to exploring the question of how labour demand responds to trade restrictions. It is scraped from tens of thousands of websites and represents the near universe of online job postings in the US and UK. Additionally, it is available at almost real-time and provides information on the location and occupation of the job posting. Employment figures, in contrast, are published with a greater delay and reflect the interaction of supply and demand, whereas job postings represent a more proximate measure of labour demand.

Chapter 1 examines how the threat introduced by the Brexit vote of future trade barriers with the EU affected labour demand in the UK. We adopt a shift-share approach, developing measures of local labour market exposure to potential future barriers on exports of goods and services to the EU. Given that the UK is a predominantly services-based economy (representing 81 percent of economic output in 2019), we particularly focus on the impact on potential impediments to service exports.

We consider the 'threat' of no trade deal being reached between the UK and the EU and evaluate the barriers that exporters would face under this scenario. For services, if the UK were to leave the EU and Single Market without a deal, it would become a third party to other EU and European Economic Area (EEA) countries and trade in services would revert to the terms set under the General Agreement on Trade in Services. For goods, no trade deal with the EU would mean reverting from tariff-free trade to trade under World Trade Organisation (WTO) terms, where the UK would face Most Favoured Nation (MFN) tariffs on its exports to the EU. We follow a difference-in-differences approach comparing job adverts in highly exposed localities to those in less exposed localities in the post-referendum period, relative to the pre-referendum period.

We find that local labour markets that were ex-ante more exposed to the threat of future trade barriers on professional services exports experienced a relative decline in online job postings after the referendum, and that this effect was stronger after the middle of 2018, and in months when there was heightened uncertainty

about future trade policy. In contrast to services, we find that the threat of future tariffs on goods does not seem to have impacted the posting of job adverts.

This chapter contributes to the literature on trade policy uncertainty, exploring the full post-referendum pre-Brexit negotiation period when dramatically different outcomes were possible. We also add to the literature on trade in services, an often under-researched and increasingly important component of global trade, and to that on the uneven local labour market impacts of trade.

Chapter 2 investigates the impact of time-varying tariff exposure on online job postings at the US commuting zone level, focusing on actual tariff changes in 2018 as opposed to expectations about future trade barriers as in Chapter 1.

After many decades of global reductions in trade barriers, 2018 saw a sharp reversal of this trend with the US unilaterally introducing large tariffs on numerous products imported from a large range of countries, and affected countries following suit with retaliatory tariffs on US exports. During this period, the World Trade Organisation was largely side-lined, with unilateral actions taken by both the US and its trade partners.

Similar to Chapter 1, I adopt a shift-share approach, constructing three exposure measures which account for the three channels of impact of tariffs on labour demand: protection against foreign competition; exposure to the increased cost of imported inputs; and exposure to retaliatory tariffs levied by third-countries on US exports.

This paper contributes to a burgeoning literature on the widespread tariff increases in 2018, which has typically focused on the direct effects on US prices or knock-on effects on voting behaviour. This chapter instead focuses on labour demand, a key policy objective of the Trump Administration.

The baseline results show that tariffs on imported inputs and retaliatory tariffs on exports both had a consistently negative impact on job postings, while the impact of tariffs on competing imports is not significant once imported input tariffs are controlled for. I also find that the US agricultural subsidies announced under the Market Facilitation Program may have increased job postings, but there is no evidence that they particularly benefited commuting zones that were more exposed to the negative effects of the retaliatory tariffs. Overall, these results paint a

negative picture of the 2018 tariffs with respect to one of their central stated goals: bringing jobs back to the US. The results are of course only short term, and the final impact on labour demand will depend on the longer term applied tariff rates and the degree of uncertainty around future unilateral utilisation of tariffs to solve bilateral disputes.

The second topic covered in this thesis looks at the usage of national tax policy to compete for internationally mobile capital, in place of international cooperation. Devereux et al. (2008) provide evidence that countries strategically set their tax rates relative to others in order to compete for this capital. In Chapter 3, I provide evidence that corporate tax rates are continuing to decrease, while the availability of tax exemptions such as corporate tax 'holidays' is increasing.

This approach to taxation risks a global race to the bottom, where competition between countries pushes corporate taxation down to very low levels, and highly profitable companies can avoid contributing to the public purse. [The text originally presented here cannot be made freely available via ORA because of copyright.]

Efforts to reverse this trend through regional and global cooperation are under way, most notably through the OECD/G20 BEPS initiative, but progress is slow. First, countries that have adopted low taxes, such as the Republic of Ireland and the Netherlands, have little incentive to adjust their policies. Second, the equilibrium of higher global tax rates is inherently unstable; the more countries that jointly raise their tax rates, the more incentive there is for a country to deviate, undercutting their competitors and potentially capturing capital flows which are geographically mobile.

Despite the revealed belief of countries that taxation policy matters for attracting capital and jobs, the empirical evidence is more mixed. Existing studies tend to find varying degrees of negative effects of corporate taxation on FDI (Bénassy-Quéré et al. (2005), Bellak et al. (2009), Egger et al. (2009), Overesch and Wamser (2009), Hebous et al. (2011), Desai et al. (2006)), though not always statistically significant (Hunady and Orviska, 2014). Studies of tax holidays studies are much less common (Allen et al. (2001), James and Van Parys (2010), Klemm and Van Parys (2012), James (2009)), but find mixed results in terms of their effectiveness.

Tax holidays (here defined as targeted exemptions from corporate tax for a specified period) in particular are potentially costly when used to attract investment. First, investors may well have set up in the country without these incentives, in which case tax holidays represent unnecessary lost revenues. Second, tax holidays may create opportunities for manipulation or distract authorities from fixing deeper, more structural issues with the business climate. Third, they may attract 'footloose' investment which does not integrate into the local economy, instead hopping between countries once their holiday has expired, chasing favourable tax provisions. These risks to the public purse stress the importance of having strong evidence on the effectiveness of these policies in reaching their proclaimed goal of attracting investment.

Chapter 3 hence analyses the impact of corporate tax rates and tax holidays on the location of inward greenfield Foreign Direct Investment (FDI) projects using a new global tax policy dataset compiled by the World Bank. This database provides a new breadth of information across 159 countries and 22 sectors, and covers a significant section of the post-financial crisis period: 2009-2015. [The text originally presented here cannot be made freely available via ORA because of copyright.]

I first present a new set of stylized facts regarding global post-financial crisis corporate tax rates and tax holidays, and second provide evidence for the FDI-tax policy relationship using a stringent fixed-effects panel specification. This specification controls for time-invariant characteristics such as a country's comparative advantage in a particular sector, worldwide sectoral trends including increases in the worldwide supply of FDI, and country-specific time-varying factors relating to the host country's macroeconomic conditions and business environment.

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In summary, this thesis assesses the effectiveness, in terms of jobs and attracting investment, of two types of national policies which lean against global cooperation. Better understanding the impacts of these policies is an important goal at a time when global integration is under pressure from several directions, and the future of this integration remains in question.

CHAPTER 1

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

with **Beata Javorcik, Katherine Stapleton, and Layla O'Kane**

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 Brexit referendum on labour demand between January 2015 and December 2019. We develop measures of local labour market exposure to the threat of 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 saw a differential decline in online job adverts in the period after the referendum, particularly for higher-skilled jobs. 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.

1.1 Introduction

The consequences of trade barriers for economic outcomes have been studied for a long time, yet the impact of uncertainty about possible future barriers, as opposed to barriers themselves, is less well understood. In addition, research that does exist on the impact of uncertainty about possible future barriers has typically focused on goods trade, rather than services trade, despite the growing role of services in global exports. With some of the world's major economies in a period of heightened uncertainty in their trade relations and the growing prevalence of deep trade agreements, which cover not just trade but other complex provisions aimed at deepening economic integration, this area of research is becoming increasingly important. The Brexit vote and its aftermath provide a unique opportunity to study the impact of trade policy uncertainty, particularly with regard to services trade.

This paper examines how the threat introduced by the Brexit vote of 'unravelling' decades worth of deep integration with the EU affected labour demand in the UK.[1] We use a high frequency dataset consisting of the near universe of job adverts posted online in the UK between January 2015 and December 2019, which allows us to evaluate the immediate labour demand response to the trade policy uncertainty caused by the referendum result and political events during the negotiation period. Figure 2.1 displays the normalised, smoothed time series of monthly job postings over the period of our analysis for both the UK and US. Both countries followed a similar trend before the referendum but started to diverge substantially from January 2018 onwards. In 2019 total job postings in the UK were 10 percent lower than in 2015, whereas in the US they were 64 percent higher.

We develop measures of local labour market exposure to potential future barriers on exports of goods and services to the EU. We take the 'threat' of no trade deal being reached between the UK and EU and evaluate the barriers that exporters would face under this scenario. For services, if the UK were to leave the

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

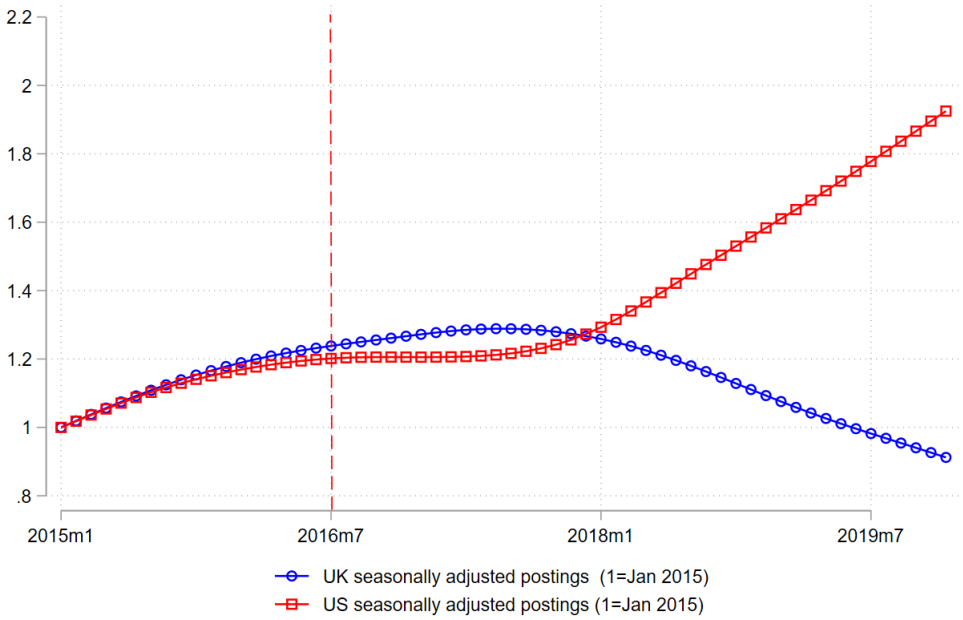


Figure 1.1: Monthly online job postings, UK and US

Notes: Both trend lines are smoothed using the Hodrick-Prescott time-series filter, removing cyclical components, and normalised to 1 in January 2015 for comparison. The vertical red dotted line identifies the date of the Brexit referendum.

EU and Single Market without a deal, it would become a third party to other EU & European Economic Area (EEA) countries and trade in services would revert to the terms set under the General Agreement on Trade in Services (GATS). The UK would then face rules set by individual member states.[2] This would represent a major shift in policy for many UK service sectors as the EU Single Market is a highly integrated area for trade in services, and in 2018 services accounted for 81 percent of UK economic output and 46 percent of exports (ONS, 2019).

We exploit pre-vote variation in the difference between the regulations that individual member states place on services trade with other EEA members and non-EEA members, in different sectors. For each export destination and sector, we construct the regulatory 'gap' between the threat of the stringent restrictions UK exporters could face and the minimal restrictions they currently face using the OECD's Services Trade Restrictiveness Index (STRI) and Intra-EEA STRI, respectively, focusing primarily on trade barriers to professional services exports. UK industries were differentially exposed to this threat of regulatory barriers depending on the pre-vote composition of their exports by country. And, in turn, local labour markets were differentially exposed to this threat based upon their pre-vote employment composition by industry.

For goods, no trade deal with the EU would mean reverting from tariff-free trade to trade under World Trade Organisation (WTO) terms, where the UK would face Most Favoured Nation (MFN) tariffs on its exports to the EU. We exploit the product-level variation in EU MFN tariffs to construct measures of the tariff threat to sectors and local labour markets.[3]

We relate the monthly job advert data for each of the UK's 213 local labour markets, named 'Travel to Work Areas' (TTWAs), to the pre-vote exposure of these TTWAs to potential future barriers on exports to the EU, controlling for the impact of the exchange rate depreciation and exposure to immigration policy changes.

[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.

[3]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

We follow a difference-in-differences approach comparing job adverts in highly exposed localities to less exposed localities in the post-referendum period relative to the pre-referendum period. We demonstrate that this strategy is warranted through several robustness checks, which show no evidence of differences in pre-trends. The result of the Brexit referendum was largely unexpected; sterling experienced its greatest one-day loss since the introduction of free-floating exchange rates in the 1970s during the 24 hours following the vote, reflecting the adjustment of market expectations to the outcome of the referendum.

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. This decline was economically meaningful: a one standard deviation increase in exposure to potential future barriers led to a 3.1 percent decrease in monthly job postings in our baseline specification, controlling for exposure to tariffs, the impact of the exchange rate depreciation, and immigration policy uncertainty. The effect was mainly felt by higher skilled job adverts, with a particular impact on postings for executives, managers and professional occupations. When broken down by professional service sectors, the effect was concentrated primarily in financial services, information services, engineering and, to some extent, legal services. In contrast to services barriers, we find that the threat of future tariffs on goods does not seem to have impacted the posting of job adverts.

The financial services sector received a lot of attention during the Brexit negotiation period because of its importance to the UK economy. In 2018, financial services alone accounted for 6.9 percent of UK GDP and 11.7 percent of all UK services exports (ONS, 2018). The issue of 'passporting' rights, which allow financial businesses authorised in any EU Member State to operate freely across the EEA, was central to the Brexit discussions because the removal of these rights was perceived as an insurmountable barrier to many of the core business operations of financial firms based in the UK.[4] We therefore also separately explore the impact of this threat to the financial service sector on labour demand. We use the fact that the UK publishes data on the regional breakdown of exports of services, which

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

is available for certain industry categories of which financial services is one. This allows us to exploit additional variation in the EU export intensity of the financial service sector across different UK regions. We find local labour markets that were more reliant on EU export intensive financial services before the vote experienced a substantial decline in the posting of job adverts after the vote and this affected lower-skilled job adverts in addition to higher skilled ones.

After the Brexit referendum took place in June 2016, three and a half years passed before the UK officially left the European Union 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, multiple failed votes in parliament and three extensions to the date when the UK would officially leave the EU. Businesses were left to interpret the political signals and adjust to regular changes in the implications of the proposed arrangements. In the second part of the paper, we therefore focus on the evolution of public perceptions and media coverage during this drawn out negotiation period.[5] We construct two measures of time-varying Brexit-induced trade-policy uncertainty. The first uses the intensity with which the UK's top ten newspapers were publishing articles mentioning both Brexit and uncertainty about future trading relationship with the EU. The second uses the Google search intensity in the UK for terms relating to both Brexit and trade policy.

Using these measures, as well as the Brexit Uncertainty Index (BUI) developed by Bloom et al. (2019), we show that the relative decline in online job adverts for regions more exposed to future professional services trade barriers was larger in months with heightened uncertainty over future trading policy arrangements with the EU. These results are not seen, however, when running a placebo test using the counterfactual of the postings that would have occurred had UK sectors followed the same trajectory as in the US, suggesting that the results do not just reflect sectoral trends.

We make a back-of-the-envelope calculation of aggregate effects, estimating that approximately 1.5 million fewer job adverts were posted between June 2016 and December 2019. At an average monthly level, this is equivalent to 6.5 percent

[5] In Section 3.2 we provide a timeline of the key events during this period.

of postings when compared to average pre-vote levels. Taken together, our results suggest that the threat of unravelling trade integration with a country's major trading partners can have substantial negative effects on labour markets through the reduced advertising of job openings. For the UK, it was the threat of barriers on trade in services, and particularly financial services, that mattered the most, rather than the threat of barriers on goods trade, despite the often greater focus on tariffs and goods supply chains during the discourse around the economic impacts of Brexit.

Our contribution to the literature consists of several elements. First, we contribute to the emerging literature looking at the immediate impacts of trade barriers and loss of market access. Amiti et al. (2019), Cavallo et al. (2019) and Fajgelbaum et al. (2020) study the consequences of the 2018 US trade war for prices, trade flows and welfare. In the context of Europe, Mayer et al. (2019) quantifies the trade-related welfare gains each country member has reaped from the European Union and the potential cost of reverting to a shallow regional agreement or WTO terms. We provide a new contribution by studying the impact of the potential loss of market access to the world's most integrated trading bloc on near real-time labour demand, proxied by online job adverts, and also by evaluating the relative labour market impact of barriers on both services and goods trade.

We also contribute to the literature on economic policy uncertainty. There is a substantial body of research showing that uncertainty affects investment, growth and employment. Rooted in the earlier work of Bernanke (1983) and Hassler (1996) who highlighted the importance of variations in uncertainty, Bloom (2009) develops a theoretical model whereby macro uncertainty shocks produce a rapid drop and rebound in aggregate output and employment as higher uncertainty causes firms to temporarily pause their investment and hiring.[6] We contribute both by focusing on trade-specific uncertainty and by investigating how the time-varying nature of trade policy uncertainty affects a real-time measure of labour demand.

We additionally contribute to the expanding literature looking specifically at trade policy uncertainty (e.g. Pierce and Schott (2016); Crowley et al. (2018a); and Handley and Limão (2017)). While these papers typically study the effect of trade

[6]For a review of the theoretical literature, see Dixit and Pindyck (1994). For a review of some of the empirical literature, see Baker et al. (2016).

policy uncertainty on trade, investment, and firm entry/exit, we consider how this feeds through to individuals through its impact on labour demand. Two recent papers that have studied the economic consequences of the uncertainty surrounding Brexit are Crowley et al. (2018b) and Graziano et al. (2018). The former paper looks at UK exporters' entry and exit from the EU market, using a difference-in-difference approach comparing firms that are differentially exposed to potentially high 'threat-point' tariffs before and after the referendum. The latter paper concentrates on uncertainty pre-referendum and its impact on the value of bilateral trade. The evidence to date has therefore tended to focus on tariffs and goods trade barriers. We provide new evidence on the impact of the services trade barriers posed by Brexit, in addition to goods trade barriers, and how both of these affected labour demand over the entire negotiation period.

Third, our paper contributes to a broader literature on the economic impacts of the Brexit referendum, providing new evidence on labour demand, another first-order consequence of the Brexit vote. Costa et al. (2019) show that the sharp devaluation of the pound on the night of the Brexit referendum resulted in a negative effect on worker salaries and training post-referendum. We follow their method to control for the impact of exchange rate changes and show that the exchange rate depreciation also had an impact on labour demand that is distinct from that of trade policy uncertainty. Our findings also support the work of Bloom et al. (2019), who study the economic policy uncertainty caused by the Brexit vote and show that more productive, internationally exposed, firms have been more negatively impacted by the aggregate uncertainty caused by Brexit than less productive domestic firms; our results suggest that this effect could be operating through the threat of future barriers on services exports. Breinlich et al. (2019) show that the Brexit vote increased outward foreign direct investment from the UK into the other EU member states. Our results point to the possibility that this could be driven by firms trying to avoid potential future trade barriers.

Fourth, we add to a broad literature on understanding trade in services that stretches from examining the benefits of services liberalization (Arnold et al. (2011), Arnold et al. (2016), Barone and Cingano (2011), Beverelli et al. (2017), Breinlich et al. (2018)) to services offshoring (Liu and Trefler (2019), Crinò (2010), Eppinger

(2019), Amiti and Wei (2005)) to the tradability of services (Jensen and Kletzer (2005), Gervais and Jensen (2019)). Regarding services trade and Brexit, Ebell (2016) and Mulabdic et al. (2017) highlight the particular importance of deep trade agreements for services trade and indicate that any deal outside the Single Market is likely to have a major impact on trade flows. We provide new evidence on how the threat of services trade barriers and unravelling deep trade agreements affects labour markets, demonstrating the important and often under-emphasised role that trade in services plays in advanced economies.

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 (2020); Deming and Kahn (2018)), 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 summarises the data sources used and construction of our exposure measures, Section 4 outlines the empirical strategy, Section 5 presents the results, Section 6 the robustness checks and Section 7 concludes.

1.2 Background on the Brexit Referendum

Table 1.1 provides a summary of the key events and dates relating to the referendum and the negotiation period.

1.2.1 The referendum

The UK electorate voted to leave the European Union on the 23rd June 2016 with a lead of 3.8 percent, against the positions held by the major political parties and to the surprise of many observers. The unexpected nature of this vote is evidenced by the betting markets that had placed the likelihood of a 'leave' outcome at around 30 percent for most of the preceding year, and the fact that the pound-dollar exchange rate fell by 8 percent in the 24 hours following the referendum (sterling's biggest one-day loss since the introduction of free-floating exchange rates in the 1970s). Furthermore, the Ipsos Mori 'Issues Index' shows that less than 10 percent of those surveyed considered the EU, Europe, or Brexit as important issues

in Britain during the ten years prior to the vote.[7] The unpredicted nature of the result is important for our analysis in that it permits us to compare the pre- and post-referendum periods in a difference-in-difference specification.

Understanding the result is complicated and multidimensional, but sovereignty was a key theme raised by the Vote Leave campaign as captured by the key slogan 'take back control'. The issue of sovereignty was of particular salience for issues of borders and immigration, UK trade policy, reallocating UK financial contributions to the EU to national concerns such as the NHS, and independence in making UK laws.[8] There is also evidence from Fetzer (2019) that the significant post-financial crisis austerity measures enacted by the UK Government led to increases in support for the UK Independence Party, which in turn strongly correlated with Leave support in the referendum.

1.2.2 Post-referendum uncertainty

The referendum was the start of an extended period of profound uncertainty about the future UK-EU relationship. The post-referendum timeline can be split into three key periods: the negotiation period following the vote but prior to leaving the EU; the transition period after leaving the EU; and the final deal. Our analysis covers the first period, starting after the referendum and ending on the 31st January 2020 with the UK leaving the EU. 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.

This period consisted of significant ups and downs including three general elections, two changes of Prime Minister, intense brinkmanship regarding leaving the EU without a deal, dramatically different competing visions for the future, and multiple failed votes in parliament. Table 1.1 presents the key events in the Brexit timeline. For each of the key policy areas affected by Brexit, it was unclear during the negotiation period which of many potential outcomes would be realised, and hence firms had to infer the probability of these outcomes from political signals.

[7] https://www.ipsos.com/sites/default/files/ct/news/documents/2019-02/issues_index_january2019_v1_internal_use_only.pdf

[8] http://www.voteleavetakecontrol.org/why_vote_leave.html

In a range of areas, to this day it remains unclear what regulations will be in place after the transition period. Consensus is now building that this has led to delayed economic responses to the referendum as firms and individuals waited for more clarity on specific issues and policies.

1.2.3 Possible future scenarios for trade policy

UK firms trading with the EU faced three main potential future trade arrangements upon leaving the EU, each with different regulatory barriers and tariff schedules: staying in the Single Market; leaving the Single Market and negotiating a comprehensive free trade deal; leaving with no deal.

The 'Single Market' outcome would ensure continued frictionless and tariff-free trade in goods and access to the European market for services. However, in this scenario the UK would not be able to freely negotiate its own trade agreements and would not have a say in future EU negotiations. Furthermore, the EU's position on the indivisibility of the four freedoms (of movement of goods, services, capital and people) meant that free movement of people would remain, and the UK would remain in the jurisdiction of the European Court of Justice. This option was ruled out at an early stage by Prime Minister Theresa May, with the EU then explicitly ruling out sector-specific arrangements that might have maintained existing benefits.[9] Single Market rules allow financial businesses authorised in any Member State to operate freely across the EEA, a system known as passporting. In November 2017, Michel Barnier, the EU's chief Brexit negotiator stated, 'The legal consequence of Brexit is that the UK financial service providers lose their EU passport'. This was the point at which it became relatively clear that the UK would not be able to maintain passporting rights.

The 'free trade deal' outcome would, in principle, allow the UK to maintain some preferential trade arrangements with the EU while retaining control over immigration, UK tariffs, and UK laws. Regarding goods, this meant no regulatory alignment but with the majority of goods being traded without being subject to tariffs. The challenges of the Irish border subsequently came to the fore, specifically the management of different regulatory regimes without having a physical

[9]See 8th January 2017 speech by Theresa May here: https://www.gov.uk/government/speeches/the-governments-negotiating-objectives-for-exiting-the-eu-pm-speech

TABLE 1.1. 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	EU 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/.

(or 'hard') border and the potential to undermine key elements of the Good Friday Agreement that was designed to maintain peace in the region. The EU insisted on introducing a 'backstop' into the transition agreement, negotiated by Theresa May, to ensure that, in the absence of a mutually agreed solution to managing the border, at least Northern Ireland would remain in the customs union of the EU. However, this transition agreement failed three times to pass through parliament, leading Theresa May to give official notice of her resignation on the 24th May 2019.

For the financial services sector, the focus moved from maintaining passporting rights to 'mutual recognition' of each other's financial services regulatory regimes. However, the concept of mutual recognition was not compliant with the EU's negotiating position of the indivisibility of the four freedoms on which the single market is based. On the 12th July 2018, the UK Government published its White Paper on 'The Future Relationship between the United Kingdom and the European Union', in which it 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 are deemed to achieve comparable outcomes.

The process of agreeing and maintaining equivalence is neither straightforward nor as all-encompassing as passporting. For example, the approach can take time, depends on wider technical or political concerns, is limited to specified services, assumes continued close regulatory alignment between parties, and can be revoked by either side at any time. The 2018 White Paper was therefore described as 'a real blow for the UK's financial and related professional services sector', by the City of London Corporation. In light of this, there is evidence that 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 elsewhere in the EU.

The final possible outcome was a 'no deal' where, for services, the UK's exports would revert to being governed only by the terms set under the GATS, and for goods, the UK would export to the EU under the EU's WTO tariff schedule

and pay MFN tariffs. 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 strengthened when Boris Johnson became Prime Minister with statements such as 'we are getting ready to come out on October the 31st. Come what may...Do or die. Come what may.'[10] This rhetoric meant that, while it had previously been seen as very unlikely that the UK would end up without a deal, from mid 2019 it started to look like a serious possibility.

In general, the possibility of trade barriers for both goods and services became increasingly likely as the negotiation period progressed. For services trade, the decision not to remain in the Single Market in early 2017 was the first move towards a substantial change in regulation for UK services exporters. For services trade it was possible that even under a preferential trade agreement, important barriers of entry for UK firms in EU markets might remain, meaning that the outlook became bleak relatively early on in the process. For financial services particularly, the crunch point came at the end of 2017 when it became clear that passporting rights would not be maintained after leaving. For goods trade, on the other hand, increased tariffs were a possibility primarily under a no deal scenario, meaning that the risk became sizable only later on. The average EU MFN tariff is also relatively low (with a trade weighted average of 3 percent in 2018), meaning that it was also less clear how much of a threat this posed to businesses in reality, with the exception of firms heavily reliant on global supply chains.[11]

1.3 Data

1.3.1 Online job adverts

We use data collected by Burning Glass Technologies (BGT), a company that scrapes, parses and deduplicates online job postings on a daily basis and creates labour market analytics products using this data.[12] BGT identify that their postings are sourced from approximately 40,000 online job boards and company websites, resulting in a sample containing nearly all job adverts posted online. For the UK there are around 60 million UK job adverts in their data over the period 2012-2019.

[10] https://www.ft.com/content/366432ce-9741-11e9-8cfb-30c211dcd229
[11] https://www.wto.org/english/res_e/statis_e/daily_update_e/tariff_profiles/E28_E.pdf
[12] Duplicates are recorded as a single posting in the first period in which the posting occurs.

TABLE 1.2. SUMMARY STATISTICS

Variables	Mean	Median	Min.	Max.	Std Dev.
Job postings:					
Monthly postings	2,442	668	1	206,743	10,225
Monthly postings - unskilled	775	265	1	48,718	2,449
Monthly postings - skilled	1,614	388	1	151,708	7,525
Monthly postings - SOC1	254	56	0	28,761	1,342
Monthly postings - SOC2	793	182	0	74,155	3,828
Monthly postings - SOC3	416	94	0	40,616	1,944
Monthly postings - SOC4	211	57	0	17,181	811
Monthly postings - SOC5	150	54	0	8,505	428
Monthly postings - SOC6	143	58	0	7,742	418
Monthly postings - SOC7	223	66	0	16,004	762
Monthly postings - SOC8	82	32	0	2,788	173
Monthly postings - SOC9	115	45	0	6,916	313
US monthly postings placebo	9,265	8,835	2,176	31,375	3,335
Exposure measures:					
Professional services exposure	0.127	0.0877	0.0323	0.548	0.0902
Financial services exposure	0.0335	0.021	0.00814	0.287	0.0346
Export tariff exposure	0.305	0.208	0.0204	4.2	0.412
Import tariff exposure	0.598	0.408	0.0423	5.52	0.732
Imported inputs tariff exposure	0.23	0.203	0.0671	0.775	0.11
Controls:					
Xrate impact via imports	0.0652	0.0652	0.0644	0.0665	0.000327
Xrate impact via exports	-0.0622	-0.0627	-0.0705	-0.0505	0.00347
EU national share	0.0465	0.0444	0.0182	0.144	0.0172
EU8 national worker share	0.0297	0.0274	0.0121	0.0624	0.0106
Uncertainty indices:					
Newspaper-based uncertainty index	4.33	4.12	2.16	7.15	1.45
Google-search-based uncertainty index	2.13	1.9	1.13	4.55	0.788
Brexit uncertainty index	44.3	39.2	34.8	58.3	7.79

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. The newspaper uncertainty index has been scaled by 100 so the mean of 4.33 represents 433 articles per month. SOC refers to the standard occupational classification, with more detail presented in Table 2.6.

In Appendix 1.A we provide a detailed discussion of BGT's data coverage relative to other sources of labour market data for the UK. We show that between 2012 and 2019 the number of job adverts included in BGT's data is approximately 86 percent of the total number of vacancies in the UK economy as reported by the ONS UK Vacancy Survey (UKVS), which conducts monthly surveys asking UK employers about their job vacancies.

The BGT data has the advantage of being very rich in detail: BGT classify the job adverts along a range of dimensions, most important for us are the detailed classification by TTWA and SOC (Standard Occupational Classification) codes. However, online job adverts data inevitably only cover the subset of all vacancies advertised online and can suffer from issues of representation by industry, geography, occupation and time. 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.

The postings cover 225 TTWAs across the UK, with 76 percent of total job postings being classified with a TTWA. The final dataset includes 213 TTWAs, due first to the exclusion of the 10 TTWAs in Northern Ireland from the BRES employment data, discussed below, and second to the exclusion of 5 small TTWAs which are not present in the BGT data. This leaves us with a final dataset with 213 TTWAs for 60 months, resulting in 12,780 observations. Table 3.1 displays summary statistics for monthly job postings and all other key variables used in the paper.

Over the period considered in our analysis, January 2015 to December 2019, a total of 31,208,288 postings are present in our dataset, translating into an average of 6,241,658 per year. Figure 1.2 displays the time series of UK monthly job postings over the period of our analysis. They follow an upwards trend before the referendum before flattening out and starting to decrease from mid-2018. We are

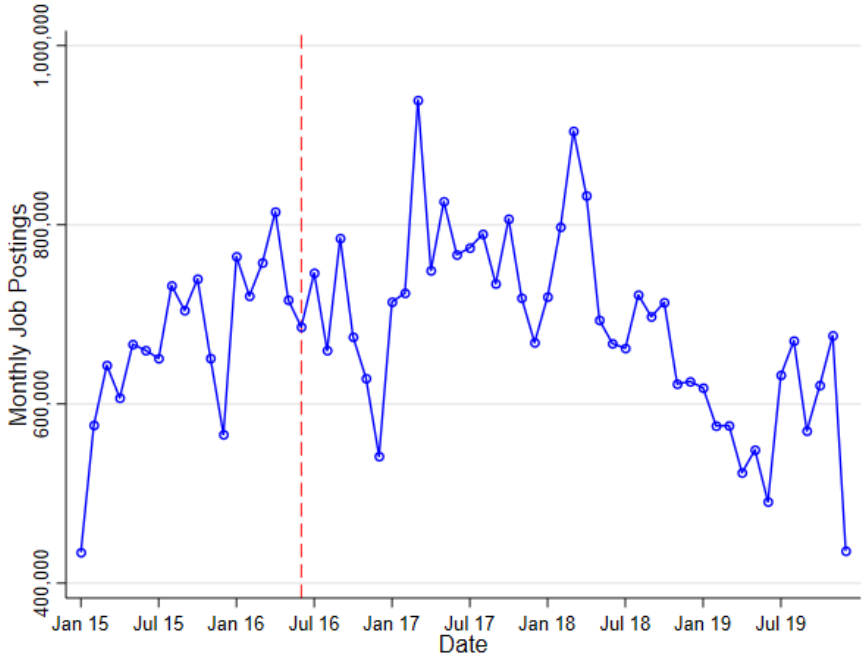


Figure 1.2: Monthly online job postings in the UK

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

interested in understanding to what extent concerns about a future relationship with the EU played into this decrease.

1.3.2 Local labour market exposure

Our analysis uses UK TTWAs as our statistical unit, which aim to reflect the geographic region where the population would generally commute to a larger town, city or conurbation for the purposes of employment.[13] The current criteria for defining TTWAs are that at least 75 percent of the area's resident workforce work in the area, at least 75 percent of the people who work in the area also live in the area, and the area must have an economically active population of at least 3,500. TTWAs range in population size from 6,800 to 8.4 million.

We use employment data from the UK Business Register and Employment Survey (BRES) for 2015 that contains a breakdown of employment by SIC4 industry

[13]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 here: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/articles/traveltoworkareaanalysisingreatbritain/2016

within each TTWA in the UK.[14] BRES collects employment information from businesses across the whole of the Great Britain economy for each site that they operate, while the same information is collected separately for Northern Ireland. BRES surveys approximately 85,000 businesses, for 2015 the BRES data includes 28.5 million employees, 91 percent of the total UK labour force as estimated by the ONS.[15] As it 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.

Our approach builds on the literature on local labour markets (e.g. Autor et al. (2014)). To calculate how exposed each local labour market is to potential future barriers to trade in professional services and goods, we first calculate a national sectoral exposure measure (defined in the following sections) before weighting this by the pre-sample sectoral employment composition for each TTWA using the BRES data discussed in the previous section.

$$\text{exposure measure}_r = \sum_{j \in r} \text{empl share}_{jr,2015} \times \text{exposure measure}_j \qquad (1.1)$$

where $\text{empl share}_{jr,2015}$ is employment in sector j and TTWA r as a fraction of total employment in TTWA r, and $\text{exposure measure}_j$ corresponds to the different trade barrier exposure measures presented in the following sections.

We ideally would like to use the employment composition before there was any possibility of Brexit. However, the sampling of BRES changed in 2015, substantially improving its coverage by including business units with a single Pay As You Earn code for which no Value Added Tax data are available. Prior to 2015, such units were excluded from the sampling frame and thus we choose to use 2015 data for the employment weights. We consider all employed individuals in a TTWA: an employee is defined as anyone aged 16 years or over that is paid directly from the payroll, in return for carrying out a full-time or part-time job or being on a training scheme. Employment includes employees plus the number of working owners who receive drawings or a share of the profits.

[14] Agricultural employment is excluded from the BRES, specifically SIC codes 0111-0150.

[15] https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/bulletins/uklabourmarket/2015-07-15

1.3.3 Professional services trade barrier exposure

Our aim is to quantify the threat of future trade barriers placed on UK exports of services if the UK were to leave the EU at the end of the transition period without a trade deal. If the UK and EU fail to reach an agreement, the UK will leave the EU's Single Market and will become a 'third country' to the EU for the purpose of services trade. Trade with the bloc will then follow the rules of the GATS of the WTO. In addition, UK businesses will face rules set by individual EU Member States.

In order to quantify the difference between the current barriers the UK faces on its services exports to the EU and the threat of what these barriers could revert to in a no-deal scenario, we make use of both the OECD STRI and the OECD Intra-EEA STRI.[16] The OECD STRI contains indices that measure MFN service trade restrictions for each country and sector, and does not take into account any specific concessions or preferential trade agreements. It was assembled by analysing laws and regulations in 34 OECD countries as well as Brazil, China, India, Indonesia, Russia, and South Africa. 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 the same five policy areas in all sectors, and are 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 the highest Non-Tariff Measures (NTMs) (market completely closed to foreign services providers), and 0 meaning a fully liberalised sector.

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, restricting cross border mergers, and requiring licenses. 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

[16]OECD Services Trade Restrictiveness Index (STRI): https://qdd.oecd.org/subject.aspx?Subject=063bee63-475f-427c-8b50-c19bffa7392d. OECD Intra-EEA STRI: https://www.oecd-ilibrary.org/trade/intra-eea-stri-database_2aac6d21-en.

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, whether there are laws or regulations to establish a process for recognising qualifications gained abroad, or limitations on the duration of stay for intra-corporate transferees.

The intra-EEA STRI identifies and catalogues policy measures that restrict trade within the EEA for 25 OECD EU member countries. The information in the intra-EEA STRI is comparable with existing information in the STRI database but also covers EU law as well as national legislation. As a consequence, it follows that the resulting indices differ across EEA member countries, reflecting differences in national legislation. The OECD STRI could therefore be seen as a worst case scenario for the UK if it leaves the EU without a trade deal; trade restrictions will revert to MFN terms and barriers will be in line with those quantified in this index. The EEA-STRI, on the other hand, could be seen as the status quo of the current restrictions for the UK while it is in the EEA and covered by these EU laws.

We combine these two indices for the overlapping subset of 24 countries included in both and use them to evaluate the 'gap' between services trade restrictions placed on countries within the EEA and the MFN services trade restrictions they place on third countries.[17] We use the 2014 version of the STRI so that these restrictions were in place prior to discussion about Brexit. 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.[18] The sectors we include are then Accounting, Architecture, Commercial Banking, Computer services, Engineering, Insurance, Legal and Telecoms.

We use data from the Office for National Statistics (ONS) on UK exports of services by service type and country in 2015 to develop an EEA trade-weighted

[17]The 24 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

[18]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.

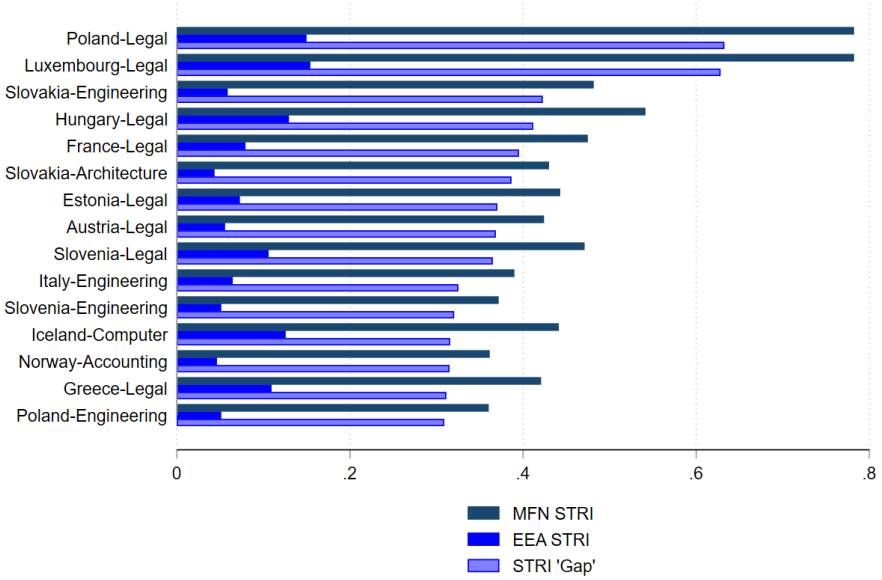


Figure 1.3: Country-sector pairs with highest STRI 'gap'

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 STRI range from 0 to 1 with 1 representing the most restrictive. *Sources*: Services Trade Restrictiveness Index, OECD.

STRI 'gap' for each of the sectors we consider.[19] We map the ONS service types to the STRI sectors using the mapping described in Table 1.13 of Appendix 1.C.[20] These sectors can then be mapped to UK SIC 2007 codes, with this mapping also included in Table 1.13. We construct the sector level professional service barrier threat as follows:

$$\text{prof services exposure}_j = \frac{\text{Exports}_{j,2015}}{\text{L}_{j,2015}} \times \text{avg STRI gap}_{j,2014} \tag{1.2}$$

where the avg STRI $\text{gap}_{j,2014}$ is the trade weighted average difference between the 2014 MFN STRI and intra-EEA STRI for industry j across EEA countries, where the weights are EEA country shares in UK exports to the EEA in sector j. $\text{Exports}_{j,2015}$ are total exports to the EEA in sector j in 2015. Expressing exports in per worker

[19] We use the 2015 trade data because exports of services by detailed service type and country was not available prior to 2015

[20] We construct the trade-weighted sector level STRI gap using the UK-EEA export shares of only the subset of countries that are included in both of the STRIs and in the ONS export data, meaning this weighted-average is over 24 EEA countries.

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

Figure 1.3 displays the top 15 country-sector pairs ranked by the difference between the MFN and intra-EEA STRIs. Legal services are the most commonly featured service type in this ranking, with the highest ranked differences being 'Legal services' in Poland, Luxembourg and 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.

We then construct measures of the professional services barrier exposure at the local labour market level as described in Section 1.3.2. Figure 1.4 presents a map of this measure by TTWA, with darker blue representing a greater professional services trade barrier exposure. There is an unsurprising concentration around the South East and London, combined with a number of very exposed areas in the North of England and Scotland. Figure 1.5 displays the 15 most exposed TTWAs: London ranks only 5th overall, with Edinburgh, Halifax, Trowbridge, Swindon and Skiption ranked as more exposed.

Financial services exposure

The UK is relatively unique in collecting detailed data on the regional breakdown of service exports. The ONS provides the value of service exports for aggregated service categories, of which Financial Services (henceforth FS) is one, originating from the 11 UK NUTS1 regions (for example North West, South West, Scotland), excluding Northern Ireland. This means that for FS specifically, we can can exploit additional regional variation in the export intensity of the FS sector which is not possible for the other professional services. Concentrating on one sector, however, comes at the cost of not being able to exploit variation across sectors of the STRI gap.

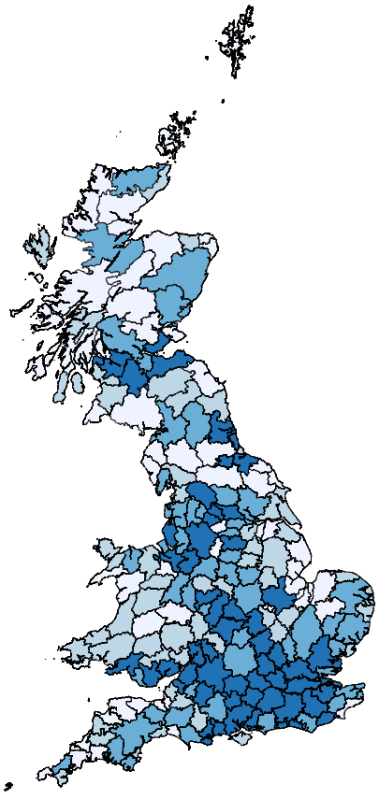


Figure 1.4: Exposure by Travel to Work Area: professional services trade barriers

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

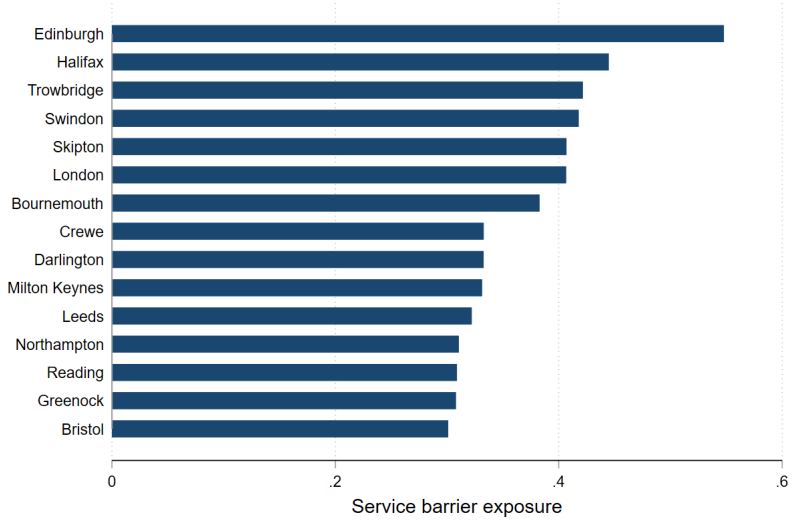


Figure 1.5: Most exposed Travel to Work Areas: professional services trade barriers

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

Within the group of professional services considered, FS is also of particular importance for the UK economy. FS alone accounted for 42 percent of the professional services exports to the EEA in the ONS data used in 2015. The FS sector in the UK is also uniquely reliant on 'passporting' arrangements with the EU, which had a distinct and important role in the negotiations, as discussed above. The loss of passporting rights was considered one of the greatest potential consequences of Brexit as these rights were essential to many business functions of financial institutions based in the UK. In the second part of the analysis, we therefore focus solely on the FS sector and explore its impact separately. We construct a measure of exposure to future barriers on exports of FS as follows:

$$\text{Regional FS exposure}_{NUTS1} = \frac{\text{Regional FS Exports to EEA}_{NUTS1,2015}}{\text{L}_{FS,NUTS1,2015}} \times \text{avg STRI gap}_{FS,2014} \quad (1.3)$$

where Regional FS Exports to $\text{EEA}_{NUTS1,2015}$ are the FS exports of UK NUTS1 region $NUTS1$ to the EEA, trade-weighted avg STRI $\text{gap}_{FS,2014}$ is defined as above and $\text{L}_{FS,NUTS1,2015}$ is UK regional employment in FS. The FS exposure of TTWA r in NUTS1 region $NUTS1$ is then:

$$\text{FS exposure}_{r,NUTS1} = \text{FS empl share}_{r,2015} \times \text{Regional FS exposure}_{NUTS1} \quad (1.4)$$

where $\text{FS empl share}_{r,2015}$ is the Financial Service (FS) share of TTWA r employment in 2015. Figures 1.15 and 1.16 in Appendix 1.B display a map of this measure of financial service sector exposure by TTWA as well as 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.

1.3.4 Tariff exposure

This section explains the construction of the sectoral export exposure to MFN tariffs. The tariffs used in the analysis are taken from World Integrated Trade Solution (WITS), and we select 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 and 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.[21]

From there we aggregate the tariffs to a per-worker sectoral measure as follows:

$$\text{tariff exposure}_{j,2014} = \frac{\text{Exports}_{j,2014}}{L_{j,2015}} \times \text{avg MFN tariff}_{j,2014} \tag{1.5}$$

where avg MFN tariff$_{j,2014}$ is the export-weighted average EU MFN ad valorem tariff across all HS6 products mapped to sector j, Exports$_{j,2014}$ are exports from the UK to the EU-27 of a particular HS6 product in 2014, and $L_{j,2015}$ is the total national employment in sector j in 2015. There are 419 sectors, of which we keep only the 147 manufacturing sectors 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, as 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 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.[22] We would therefore expect that the perceived risk of harm from future import tariffs would be substantially lower than the risk of harm from tariffs on UK exports, which were widely

[21] The relevant crosswalks can be fond here: unstats.un.org/unsd/classifications/econ/. We use CPC Ver 2.1 as an intermediate nomenclature between HS 2012 and ISIC Rev. 4. 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.

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

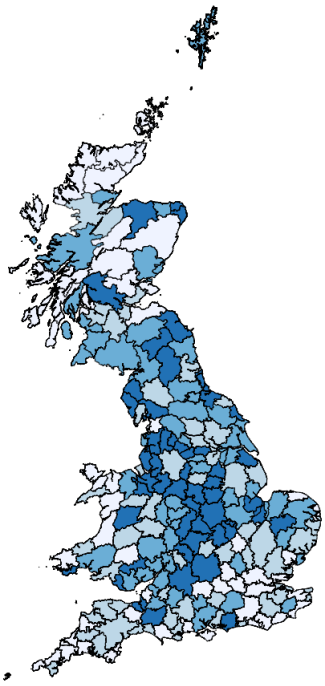


Figure 1.6: Exposure by Travel to Work Area: MFN tariffs

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

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 the Robustness section.

We then construct measures of the MFN tariff exposure at the local labour market level as described in Section 1.3.2. Figure 1.6 provides a map of the exposure measures and Figure 1.7 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. The map shows a concentration in the Midlands with relatively little exposure in the South East and London, in contrast with the professional services exposure.

1.3.5 Classifying job adverts by occupation and skill

The job postings data provides 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'.

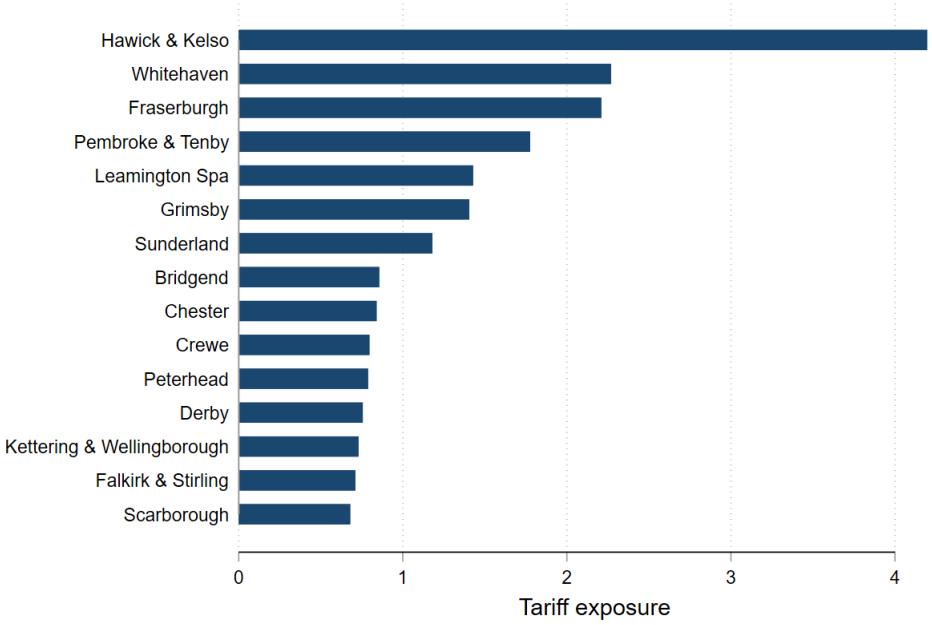


Figure 1.7: Most exposed Travel to Work Areas: MFN tariffs

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

These can be aggregated to nine 1-digit groups as presented in Table 2.6.

The ONS classifies the 2-digit sub-major groups of the SOC 2010 into four skill levels where 'skill level is defined with respect to the duration of training and/or work experience recognised in the field of employment concerned as being normally required in order to perform the activities related to a job in a competent and efficient manner'.[23]

We define the top two levels (3 and 4) as 'high skill' and the bottom two (1 and 2) as 'low skill'. Examples of high skill sub-major groups include 'Science, research, engineering and technology professionals' (level 4) and 'Business and public service associate professionals' (level 3). Examples of low skill sub-major groups include 'Administrative occupations' and 'Elementary trades, plant and storage related occupations'. Figure 2.5 displays the evolution of high skill and low skill job postings over time, we see a clear gap between the progression of the two types with high skill postings overall decreasing, and low skill postings

[23]https://www.ons.gov.uk/methodology/classificationsandstandards/standardoccupationalclassificationsoc/soc2010

TABLE 1.3. 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. *Source*: ONS Standard Occupational Classification.

slightly increasing over the period.

1.3.6 Measures of trade policy uncertainty

Our objective is to estimate the labour demand response to uncertainty surrounding the likelihood that UK firms will be subject to services barriers or MFN tariffs when exporting to the EU after Brexit. Although uncertainty is challenging to define and measure, we build on previous efforts in the literature and develop proxies which measure uncertainty using the time-varying prevalence of terms mentioned in newspaper articles and google searches. We then compare the results using these indices to the measures of general Brexit-induced uncertainty in the BUI from the Decision Maker Panel (DMP) survey, constructed by Bloom et al. (2019), discussed more below.

Newspaper coverage

Our first approach uses UK newspaper coverage and builds closely 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, but focuses specifically on the trade uncertainty caused by the Brexit referendum. 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

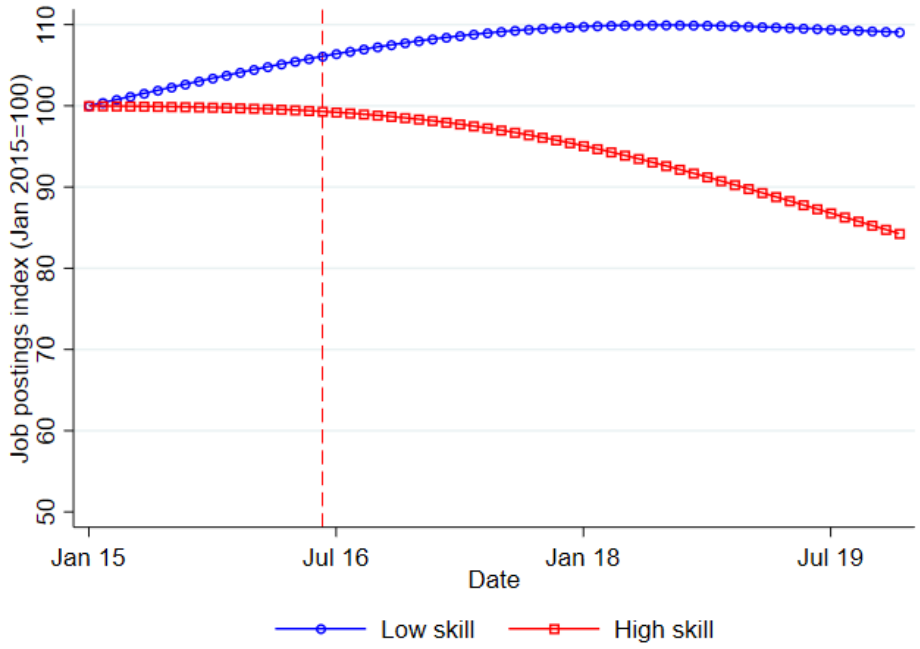


Figure 1.8: Skilled and unskilled job postings over time

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

TABLE 1.4. 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.

leaves us with a condensed list of 6 trade related terms: 'trade', 'tariffs', 'WTO', 'World Trade Organisation', 'trade policy', and 'trade agreement'. 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 are interested in 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 1.4 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: The Daily Mail, The Sun, The Mirror, The Express, The Times, The Telegraph, The Guardian, The Independent, The Daily Express and The Metro. Our data comes from Factiva, a news aggregator, and covers the period 2015-2019. This index is displayed in Figure 1.9 for the negotiation period, which is the focus of our analysis, normalised to 1 for September 2016 so that the three indices considered are comparable for the period when the BUI is available, discussed below. 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. Newspaper coverage remained high until

March 2019, when the government put in a request to extend Article 50.

Google searches

Our second approach is to use an index of Google searches.[24] Google searches offer an alternative way to gauge the degree of public concern surrounding Brexit and future trade policy, through directly observing what people are searching for. Google Trends provides public information on the Google searches conducted within a given region over time.[25] We use searches for the same terms as for the newspaper measure, but exclude the uncertainty-related terms. 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 1.9 displays the normalised google trends measure for the post-vote period alongside the two other measures. Similarly to the newspaper measure, this measure has a marked peak in late 2018 in a similar location to the peak of newspaper coverage, but the latter is much more muted. There is significant month-to-month variation across both measures.

BUI

In addition to the two uncertainty measures discussed above, we also compare our results using the BUI from the DMP survey.[26] The DMP is a panel survey of 8,000 firms, with around 3,000 responding in any given month. The BUI is defined as the share of firms which rate Brexit as one of the three highest drivers of uncertainty for their business.[27] Figure 1.9 compares the BUI with our two uncertainty measures

[24] An alternative was to follow the approach in papers such as that by Graziano et al. (2018) and use prediction markets to gauge uncertainty. These authors use the average daily price of a contract traded in PredictIt.org paying $1 if a majority voted for Brexit in the referendum as a measure of pre-referendum trade policy uncertainty. However, betting markets tend to release contracts on narrowly defined questions over a limited period of time. Since we aim to measure the perceived probability of firms facing MFN tariffs 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.

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

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

[27] More information can be found in Bloom et al. (2019)

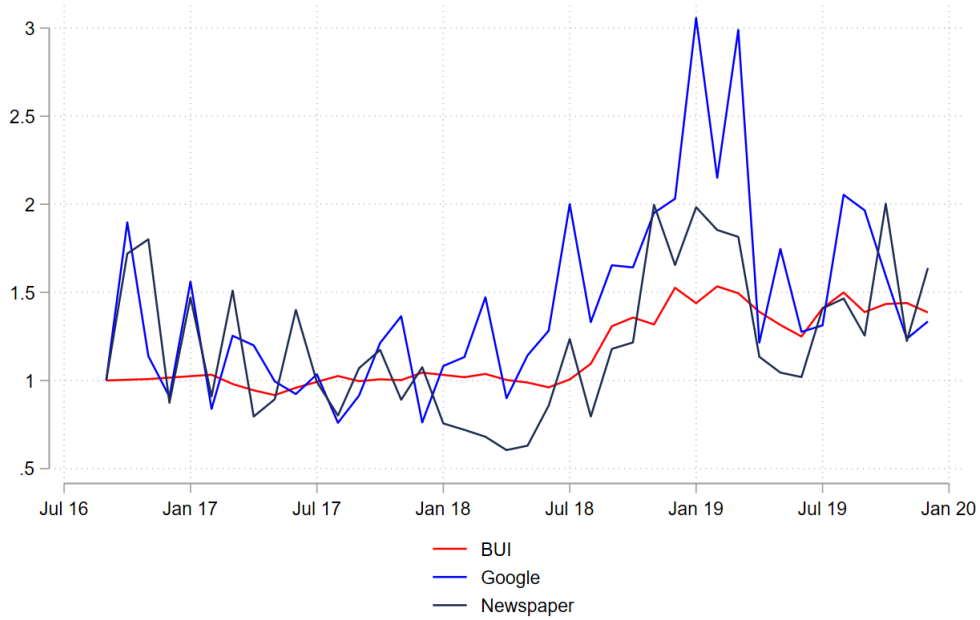


Figure 1.9: Brexit trade policy uncertainty measures

Notes: For illustrative purposes the measures are normalised to 1 on September 2016, non-normalised versions are used in regressions for simplicity. The BUI originates from the UK DMP Survey. 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.

from September 2016, when the BUI starts. All follow similar trends, although the BUI has a lower variance and fluctuates less than our measures.

1.3.7 Control variables

The Brexit referendum also introduced other factors which may have affected the posting of online job adverts during this period. We focus on four key control variables capturing changes to the expected supply of EU or EU8 nationals working in the UK, and the sharp depreciation of the pound sterling after the referendum.[28] Below we discuss the construction of the immigration controls and the exchange rate variables.

Accounting for immigration policy uncertainty

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 combines data from two waves of the main Labour Force Survey (LFS) with data collected on a local sample boost. The datasets comprise 12 months of survey data and are disseminated quarterly, with an achieved sample size of approximately 320,000 respondents. The APS is the most comprehensive source of data on employment by nationality of workers and is typically used for research on immigration in the UK.

The data provide a breakdown of the share of employment of EU and EU8 nationals in each UK NUTS1 region and SIC1 industry. We use data on the SIC1 employment composition of each TTWA in a given region to construct the employment share measures. A map of these measures is displayed in Figure 1.17 of Appendix 1.B.

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

[28]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.

introduced substantial uncertainty surrounding freedom of movement of people between the UK and EU and 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 EU8 nationals in the pre-referendum period, interacted with the post-referendum dummy. We hypothesise that firms relying on EU workers may take the referendum and risk of a no deal as a negative shock to their businesses and hence may reduce hiring until clarity of future arrangements is restored. The measure is defined as:

$$\text{EU national share}_{r,NUTS1} = \sum_{k \in r} \text{empl sh}_{kr,2015} \times \frac{\text{EU workers}_{k,NUTS1}}{\text{L}_{k,NUTS1}} \tag{1.6}$$

where r is the TTWA, $NUTS1$ is the NUTS1 region in which the TTWA is located, and k the SIC1 sector. Total workers, $\text{L}_{k,NUTS1}$, 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, which include: Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia.

Accounting for the exchange rate depreciation

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. UK firms are likely to have been affected by this depreciation, both through increased cost of imported inputs, and through increased competitiveness of export products. The depreciation was also not equal with respect to different currencies, for example, the pound-dollar exchange rate fell by 8 percent overnight on June 23/24 while the pound-euro exchange rate fell by 6 percent. Since imports and exports differ in their source and destination countries, industries trading in different world markets faced a different effective sterling depreciation. The differential cost and revenue shocks from these country specific variations in the unexpected sterling depreciation therefore affected industries differently (Costa et al., 2019). If these sector-specific changes across time are correlated with the threat of services trade

restrictions or MFN tariffs then we may be concerned that our key estimated impact is biased.

Following Costa et al. (2019), we include controls for the sector-specific (2-digit SIC) exposure to the exchange rate depreciation both in terms of exports and imported inputs. These controls are constructed as follows.[29] The intermediate import weighted exchange rate change (where the depreciation corresponds to a *positive* value i.e. more expensive inputs) is:

$$\hat{E}_o^M \equiv -\sum_i \sum_{s \neq uk} S_{sio} \hat{E}_s$$

where s indexes the source country for imported inputs, o the output industry, i the input industry, and M imports. $\hat{E}_s$ is the change in the exchange rate between the pound sterling and source country currencies, where a depreciation corresponds to $\hat{E}_s < 0$. S_{sio} is the share of intermediates of industry i from source country s in the factor expenditures of industry o.

The export weighted exchange rate change (where the depreciation corresponds to a *negative* value i.e. reduced prices of UK exports in the foreign currency) is:

$$\hat{E}_o^X \equiv \sum_{d \neq uk} S_{dxo} \hat{E}_d$$

where d indexes the destination country for exports, o the output industry, and x exports. $\hat{E}_d$ is the change in the exchange rate between the pound sterling and destination country currencies, where a depreciation corresponds to $\hat{E}_d < 0$. S_{dxo} is the share of destination d in exports of UK firms in output industry o.[30] We then construct measures of the exchange rate exposure at the local labour market level as described in Section 1.3.2. Figure 1.17 in Appendix 1.B provides maps of these measures by TTWA.

[29] We multiply both definitions by -1 to aid with interpretation in our particular context.

[30] This one day currency depreciation was not the only depreciation in the period studied. For example, the USD to GBP rate saw a maximum of 1.72 in July 2014 and a minimum of 1.23 in January 2017, changes that are far larger that the 8 percent decrease on the day of the referendum. However, given the lack of exogeneity of a concurrent exchange rate as a control, we are unable to control for other exchange rate fluctuations during the period, but at least control for this one particularly sudden change.

1.4 Empirical strategy

1.4.1 Baseline specification

Our baseline specification estimates the impact of the post-referendum period on monthly online job postings in UK TTWAs as a function of a labour market's exposure to future potential trade barriers over the period of January 2015 to December 2019. We estimate the following model:

$$\begin{aligned}\log(\text{postings}_{rt}) =& \beta_0 + \beta_1 \text{trade barrier threat}_r \times \text{post vote}_t + \beta_2 \text{X}_r \times \text{post vote}_t \\ &+ \gamma_t + \gamma_r + \epsilon_{rt} \end{aligned} \tag{1.7}$$

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

We do not include the post-vote variable on its own as our specification includes month-year dummy variables. Equally we include TTWA fixed-effects to control for TTWA-specific, time-invariant factors. We are also interested in the impact of trade policy uncertainty for different skill and occupations groups and so we run the specification in (2.5) separately for each category of job postings, with these categories defined in Section 1.3.5.

1.4.2 Time-varying trade policy uncertainty

The outcome of the referendum introduced a large overnight changes in perceptions about future trade policy arrangements between the UK and EU. We proxy for this step change initially through our post vote_t dummy. However, the degree of uncertainty varied substantially in the period after the referendum as the negotiations continued with a significant lack of clarity regarding the different possible trade policy outcomes. We therefore also explore how the impact of exposure to professional service export barriers or future MFN tariffs varied during the post-vote period as a function of the proxies for Brexit-induced trade-policy uncertainty.

We consider the following specification:

$$\log(\text{postings}_{rt}) = \beta_0 + \beta_1 \text{trade barrier threat}_r \times \text{uncertainty}_t + \gamma_t + \gamma_r + \epsilon_{rt} \quad (1.8)$$

where uncertainty$_t$ is one of the measures of uncertainty in month-year t. For this specification we focus on the post-referendum negotiation period, such that we evaluate differences in the impact of trade barriers within the period when the Brexit vote result had already been announced.

1.5 Results

1.5.1 Baseline post-vote results

We start with our baseline specification laid out in equation 2.5 before gradually adding controls. The results are presented in Table 3.2. Column (1) shows the coefficient on the interaction term between the post vote dummy variable and the TTWA trade weighted professional services exposure measure, and column (2) additionally includes the tariff exposure measure. Columns (3)-(5) subsequently add the controls described earlier in the paper. Across all columns, the estimated coefficient on the interaction with the professional services measure is negative and significant at the 1 percent level with the magnitude varying between -0.344 and -0.540. Taking column (4) as our preferred specification, a one standard deviation increase in exposure (0.09) leads to a 3.1 percent decrease in monthly postings. The estimated coefficient on the interaction with the tariff measure is close to zero and insignificant across all specifications.

Turning to controls, the export exchange rate coefficients are positive and significant across all specifications. This implies that TTWAs that were more exposed to a reduction in relative prices of UK exports abroad experienced a decrease in postings after the vote. This is surprising as we might have expected that the depreciation would have increased the competitiveness of exporting firms. We cannot ascertain what is driving this result but hypothesise that it could perhaps reflect the impact of the uncertainty caused by the exchange rate shock, or that the decline in relative prices for UK goods abroad was more than offset by more costly intermediate inputs. A one standard deviation increase in exchange rate export exposure (0.0034) is associated with a decrease in hiring of 3.1 percent. The import

TABLE 1.5. BASELINE POST-VOTE RESULTS

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * prof service exposure	-0.538***	-0.540***	-0.351***	-0.346***	-0.344***
	(0.132)	(0.132)	(0.124)	(0.124)	(0.128)
post vote * tariff exposure		-0.008	0.001	0.003	0.001
		(0.033)	(0.035)	(0.035)	(0.035)
post vote * xrate impact via imports			-74.18	-81.09	-76.97
			(52.49)	(50.31)	(50.49)
post vote * xrate impact via exports			7.888*	9.084**	8.587**
			(4.194)	(4.065)	(4.277)
post vote * EU national share				0.639	
				(0.797)	
post vote * EU8 national share					0.556
					(1.341)
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
Clustering	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 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.

exchange rate coefficient is negative across all specifications. The negative coefficient implies that exposure to relatively more expensive imported inputs due to the sterling depreciation reduced the posting of job adverts after the vote. However, the estimates just miss significance at the 10 percent level (p-value=0.11 for column (4)). Finally, the interactions with the share of EU employees and EU8 employees are insignificant throughout.

1.5.2 Professional services impact over time

To evaluate how the professional services exposure affected postings throughout the negotiation period, we estimate a specification including interactions of the exposure measure with dummies for each quarter. Figure 1.10 plots the estimated coefficients. Quarters 1 & 2 from 2015 are excluded so all coefficients are relative to these quarters, and 95 percent confidence intervals are displayed vertically. We also control for the EU immigrant share and the post referendum exchange rate controls interacted with the post-vote dummy, and for month-year and TTWA fixed effects.

The pre-referendum coefficient estimates are close to zero and statistically insignificant, providing evidence that the professional services exposure was not affecting postings prior to the referendum. For several quarters after the referendum, the coefficients gradually become more and more negative, though remain insignificant. The first significant coefficient is in Q2 2018 followed by consistently negative and significant coefficients for the rest of the negotiation period. The delayed effect 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 could 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 and that mutual recognition was unlikely to be possible.

1.5.3 Negotiation period uncertainty results

Our baseline results use a straightforward interaction of the professional services exposure with a post vote dummy. Although our specification controls for time-invariant TTWA-specific factors with the inclusion of TTWA fixed effects, and common time-varying factors are controlled for with year-month fixed effects, the approach might still be susceptible to the possibility that we are just capturing sector-specific variation over time.[31] In addition, 3.5 years passed between the referendum and the UK leaving the EU, a long time period in which a lot of political changes occurred and perceptions about the likely scenarios for Brexit will have changed substantially.

In order to address this concern, we interact our exposure measures with the three time varying uncertainty measures: the Google Brexit index, the Newspaper Brexit index, and the BUI. We focus on the period after the referendum starting in

[31] One such potential concern is the EU service barriers or MFN tariffs tend to be high in declining industries because EU countries are trying to protect these industries from competition to slow down the process of job losses. If some UK regions in our analysis are dominated by such declining industries, we might mistakenly attribute their worsened job market performance to the Brexit shock. This concern is attenuated, however, by the fact that trade barriers are negotiated at the supranational level and the UK doesn't have direct control over the specific industries that get protected, although it may be able to achieve protection either through effective negotiation, or through shared interests with other EU states.

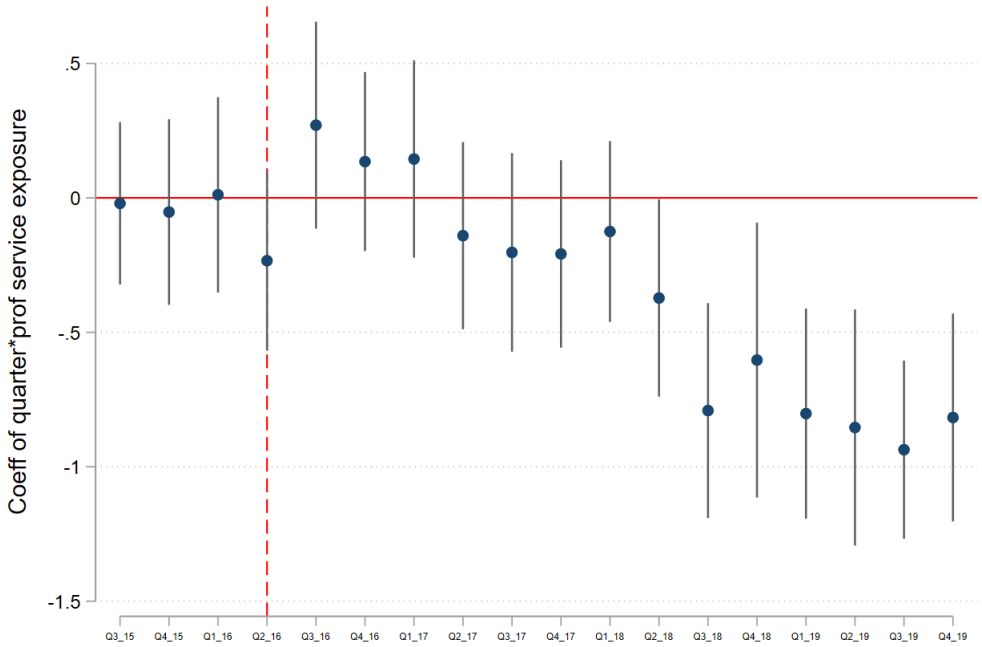


Figure 1.10: Impact of professional services exposure over time

Notes: This graph shows the coefficients from the regressions of the log of monthly job postings on the professional services barrier exposure measure at the TTWA level interacted with a dummy variable for each quarter from Q3 2015 to Q4 2019. Regressions also controlled for the EU immigrant share and the exchange rate measures interacted with the post vote dummy variables, TTWA fixed effects and month-year fixed effects. Coefficients are relative to the base period of Q1 2015 and Q2 2015. The dots represent the point estimates and the lines the 95 percent confidence intervals. The red line shows the quarter when the referendum occurred, Q2 2016.

September 2016, the first date for which the BUI is available. The specifications now exclude the exchange rate controls as these pertain specifically to the post-referendum devaluation, and TTWA fixed effects control for the effects of this one-time devaluation over the post-referendum period

Table 1.6 presents the results for all three uncertainty measures. As before, the tariff exposure interaction remains insignificant across 5 out of 6 specifications, confirming the results that businesses did not appear to be adjusting hiring as a response to a fear of no deal tariffs. For professional services exposure, the coefficients are negative and highly significant for both the Google and BUI measures, whereas the coefficients for the newspaper interaction are negative but weaker in significance. Taking the Google index as an example (column (1)), we see a coefficient of -0.23. For the mean exposure measure (0.127), an increase in uncertainty from the 25th to the 75th percentile (1.57 to 2.53) leads to a 2.8 percent decrease in monthly postings. The equivalent for the Newspaper measure is a decrease of 1.8 percent, and the BUI measure sees a decrease of 6.3 percent.[32]

We also now find negative and significant coefficients across all specifications for the EU and EU8 national shares, with the latter being larger in magnitude. Again taking column (1), for the mean value of the EU national shares (0.047) an increase from 25th to 75th percentile of the Google index decreases monthly postings by 8.5 percent. The equivalent for the EU8 share is a reduction of 8.3 percent. This result is consistent with the hypothesis that regions with a greater employment share of EU (or EU8) nationals before the vote were negatively affected by the threat of changes to immigration policy and so reduced the posting of vacancies in periods when there was heightened uncertainty relating to Brexit.

Table 1.15 in Appendix 1.C also presents additional specifications, which provide supporting evidence for the specific importance of monthly variation in these uncertainty measures above and beyond sectoral trends. All specifications make use of the full sample period and instead include a post vote * uncertainty measure * professional services exposure interaction term.[33] The results for the Google and BUI indices remain robust and the newspaper uncertainty index

[32]The larger effect for BUI may be linked to the fact that it covers a broader definition of uncertainty than the trade specific measures.

[33]For the BUI, given it starts in September 2016, we extrapolate backwards using the September value for July and August 2016.

TABLE 1.6. UNCERTAINTY MEASURE RESULTS

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)	(6)
	Google		Newspaper		BUI	
measure*prof service exposure	-0.231***	-0.268***	-0.066*	-0.083*	-0.034***	-0.039***
	(0.058)	(0.060)	(0.039)	(0.042)	(0.007)	(0.007)
measure *tariff exposure	-0.007	-0.001	0.008	0.011**	-0.000	0.000
	(0.011)	(0.011)	(0.005)	(0.005)	(0.002)	(0.001)
measure*EU national share	-1.907***		-0.826***		-0.264***	
	(0.349)		(0.239)		(0.042)	
measure*EU8 national share		-2.900***		-1.249***		-0.413***
		(0.524)		(0.398)		(0.062)
Observations	8,520	8,520	8,520	8,520	8,520	8,520
Adjusted R-squared	0.987	0.987	0.987	0.987	0.987	0.987
TTWA FE	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 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.

now generates highly significant negative results. We then iteratively control for either the post vote or quarter interaction terms, demonstrating that the results for Google and BUI remain robust to these specifications.

1.5.4 US placebo test

To provide further evidence that our results are not capturing global sectoral trends affecting the professional services sectors at the same time as our uncertainty measures peaked, we run a placebo regression using US postings mapped to UK TTWAs as the dependent variable. The aim of this exercise is to evaluate how job adverts would have responded, had the UK followed similar sectoral trends in job adverts to those that occurred in the US.

To construct a placebo at the UK TTWA level, we take the sector level time varying postings data from the US and weight it by the 2015 BRES pre-vote employment shares as follows:

$$\text{US postings}_{rt} = \sum_{j \in r} \text{empl share}_{jr,2015} \times \text{US postings}_{jt}$$

TABLE 1.7. US PLACEBO TEST

Dep variable: log US postings	(1)	(2)	(3)	(4)	(5)	(6)
	Google		Newspaper		BUI	
measure*service barrier exposure	0.002	0.002	-0.001	-0.001	-0.000	-0.000
	(0.017)	(0.016)	(0.007)	(0.007)	(0.002)	(0.002)
measure *tariff exposure	-0.001	-0.001	-0.000*	-0.000*	-0.000	-0.000
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
measure*EU national share	-0.037		0.002		-0.011*	
	(0.052)		(0.033)		(0.007)	
measure*EU8 national share		-0.058		-0.006		-0.019*
		(0.078)		(0.048)		(0.011)
Observations	8,520	8,520	8,520	8,520	8,520	8,520
Adjusted R-squared	0.994	0.994	0.994	0.994	0.994	0.994
TTWA FE	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 based on US sectoral trends on the average trade barrier exposure measures at the TTWA level interacted with varying uncertainty measures. The period 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. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

We first map the 6-digit North American Industry Classification System (NAICS) code, the US sector classification, to the 4 digit SIC codes, the UK equivalent.[34] Although there is a chance that US postings were also affected by the Brexit vote, we assume that this impact in the US would be far more muted than in the UK. If the professional services sectors that are threatened by high export barriers in the EU were globally on a downward trend relative to other sectors, and if our results were being driven by these trends occurring at similar times to when there was greater uncertainty, then we would expect to find similar results to our baseline in this US placebo regression.

Table 1.7 repeats the analysis in Table 1.6 with uncertainty interactions, now replacing UK postings by our US postings placebo. We find that none of our variables are statistically significant, even at the 10 percent level, hence supporting the claim that the changes we see in the UK are specifically caused by the threat of trade barriers and were not patterns also experienced in the US at these times.

[34]We use a crosswalk from the US Census Bureau (https://www.census.gov/eos/www/naics/concordances/concordances.html)

1.5.5 Impact on different skill groups

Table 2.5 displays our baseline regressions run separately for high skilled and low skilled job adverts, the classification of which is described in Section 1.3.5. Panel (a) shows the effect for high skilled job adverts, while Panel (b) shows the effect for low skilled job adverts. Relative to the baseline coefficients, we find that the high skilled professional service exposure coefficients are all strongly statistically significant and larger in magnitude, whereas the low skilled coefficients are mostly not significant. Taking the column (4) high skill results, we see that a one standard deviation increase in exposure leads to a 3.9 percent decrease in postings (compared to 3.1 percent for aggregate postings). This is intuitive, given professional services typically involve higher skilled jobs, particularly those that are involved in exporting.

We also find a negative and weakly significant coefficient for the import exchange rate measure for high skilled postings, where a one standard deviation increase leads to a 2.9 percent decrease in high skill postings. This is consistent with the explanation that firms that were more exposed to increases in the cost of their imported inputs reduced hiring for high skilled positions. The same effect is found for increasingly competitive exports, where a one standard deviation change in exchange rate leads to a 3.1 percent increase. Again, this is less straightforward to interpret but may be due to a step increase in uncertainty. EU shares are insignificant across both postings measures.

1.5.6 Breakdown by subsector

Our measure of professional services exposure comprises of variation across 9 subcategories. In order to better understand what is driving the change in job postings, Table 1.9 shows the results with the professional services exposure broken down into its constituent parts, while the dependent variable remains total job postings in the TTWA for each year-month.[35]

[35]More explicitly, TTWA-level professional services measure is split into measures for each component sector i.e. for sector j, all sectoral professional services exposure measures $i \neq j$ are set equal to zero when weighting by TTWA employment shares in equation 1.1.

TABLE 1.8. IMPACT BY SKILL GROUP

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
	Panel (a) High skilled				
post vote * prof service exposure	-0.637***	-0.635***	-0.433***	-0.428***	-0.429***
	(0.132)	(0.132)	(0.137)	(0.138)	(0.141)
post vote * tariff exposure		0.009	0.018	0.020	0.018
		(0.032)	(0.034)	(0.034)	(0.034)
post vote * xrate impact via imports			-81.38*	-88.19*	-82.67*
			(47.58)	(46.30)	(46.23)
post vote * xrate impact via exports			7.753*	8.936**	8.077*
			(4.108)	(3.968)	(4.230)
post vote * EU national share				0.632	
				(0.811)	
post vote * EU8 national share					0.258
					(1.379)
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 skilled				
post vote * prof service exposure	-0.280**	-0.283**	-0.180	-0.173	-0.164
	(0.127)	(0.127)	(0.119)	(0.117)	(0.121)
post vote * tariff exposure		-0.017	-0.008	-0.004	-0.007
		(0.037)	(0.039)	(0.038)	(0.039)
post vote * xrate impact via imports			-32.19	-41.68	-37.99
			(53.76)	(51.41)	(51.55)
post vote * xrate impact via exports			7.478	9.123*	8.933*
			(4.746)	(4.651)	(4.823)
post vote * EU national share				0.875	
				(0.764)	
post vote * EU8 national share					1.152
					(1.321)
Observations	12,766	12,766	12,766	12,766	12,766
Adjusted R-squared	0.976	0.976	0.976	0.976	0.976
TTWA FE	YES	YES	YES	YES	YES
Month-Year FE	YES	YES	YES	YES	YES

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

TABLE 1.9. PROFESSIONAL SERVICE RESULTS BREAKDOWN BY SUB-SECTOR

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * finance barrier exposure	**-0.499*** **	**-0.492*** **	**-0.461*** **	**-0.454*** **	**-0.471*** **
	(0.142)	(0.142)	(0.149)	(0.152)	(0.153)
post vote * engineering barrier exposure	**-6.284*** **	**-6.208*** **	**-5.731** **	**-5.501** **	**-6.068** **
	(2.238)	(2.256)	(2.490)	(2.636)	(2.722)
post vote * info services barrier exposure	**-3.815** **	**-3.858** **	**-3.740** **	**-3.804** **	**-3.696** **
	(1.778)	(1.772)	(1.785)	(1.775)	(1.759)
post vote * legal barrier exposure	-3.544	-3.630	**-4.154***	**-4.157***	**-4.221***
	(2.231)	(2.231)	(2.248)	(2.242)	(2.308)
post vote * insurance barrier exposure	1.136*	1.138*	1.040	1.032	1.046
	(0.589)	(0.588)	(0.651)	(0.655)	(0.651)
post vote * telecoms barrier exposure	-0.468	-0.545	-0.589	-0.544	-0.668
	(0.942)	(0.931)	(0.863)	(0.865)	(0.868)
post vote * computer barrier exposure	-0.800	-0.788	-0.065	-0.098	-0.038
	(0.783)	(0.780)	(0.890)	(0.894)	(0.884)
post vote * accounting barrier exposure	-1.904	-1.965	-1.774	-1.825	-1.740
	(2.794)	(2.811)	(2.970)	(2.969)	(2.963)
post vote * architecture barrier exposure	-5.654	-9.794	1.665	2.906	-1.725
	(57.43)	(58.78)	(56.38)	(56.63)	(57.87)
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 as in the baseline Table. Column (1) only includes the professional services exposure interactions, column (2) additionally includes the tariff exposure interaction, column (3) adds import and export exchange rate controls, column (4) also includes the EU national share interaction whereas column (5) instead includes the EU8 national share interaction. All specifications include controls for the sterling depreciation's impact on imports and exports, as well as the EU national share, and TTWA and month-year fixed effects. Standard errors (in parentheses) are two-way clustered at the TTWA and month-year level. *** p<0.01, ** p<0.05, * p<0.1.

The overall professional services results are primarily driven by 3 out of the 9 subcategories: financial services, information services, and engineering services. Given the importance of financial services in these regressions and in the UK economy more broadly, as well as its prevalence in the discussions surrounding a future Brexit deal, in Section 1.5.8 we focus solely on this sector to better understand its specific impact on hiring.

1.5.7 Aggregate effects

In order to provide a rough idea of what these results for professional services may have implied for the full sample, we carry out a back-of-the-envelope counterfactual exercise on our baseline results. For each TTWA, we consider what the predicted values for monthly postings after the vote would have been if they had the exposure score of the 10th percentile TTWA in terms of professional services exposure. This exercise relies on two simplifying assumptions. First, the total effects on postings equal the sum of the direct effects on postings at each TTWA. Second, TTWAs below the 10th percentile in terms of professional services exposure did not change their posting of job ads after the vote in response to the threat of future service export barriers.

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

$$\text{log postings}_{rt}^{\tau} = \text{E}\Big[\text{log postings}_{rt} | \text{exposure}_r = \text{exposure}_r^{\tau}\Big] \tag{1.9}$$

$$= \widehat{\text{log postings}}_{rt} + \hat{\beta}\left[\text{exposure}_r^{\tau} - \text{exposure}_r\right] \tag{1.10}$$

where $\hat{\beta}$ and $\widehat{postings}_{rt}$ are the estimated coefficient and the fitted values from our baseline regression in column (4) of Table 3.2. Then the total monthly loss of postings due to the threat of trade barriers is:

$$\text{Total monthly loss}_t = \sum_{\text{r: exposure}_r > \text{exposure}_r^{\tau}} \Big[\exp(\text{log postings}_{rt}^{\tau}) - \exp(\widehat{\text{log postings}}_{rt})\Big] \tag{1.11}$$

This expression gives the total loss across all affected TTWAs in a single month t. Taking τ as the 10th percentile, this exercise implies that after the vote the mean monthly decline, taken over TTWA and months, in the number of job postings relative to this counterfactual was 164. Totalling across all TTWAs, each month there were on average 34,980 fewer job adverts posted than this counterfactual benchmark (calculated by averaging equation 1.11 over months). The mean monthly number of job adverts posted prior to the vote across all TTWAs was 535,397, so this full sample effect implies a 6.5 percent loss in monthly job adverts on average after the vote for the full sample. Summing up over the whole post-vote period, this implies a cumulative loss of approximately 1.5 million job postings.

TABLE 1.10. FINANCIAL SERVICES POST-VOTE BASELINE

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * financial services exposure	-1.201***	-1.201***	-0.817***	-0.868***	-0.826***
	(0.296)	(0.295)	(0.279)	(0.254)	(0.269)
post vote * tariff exposure		-0.003	0.004	0.007	0.004
		(0.033)	(0.035)	(0.035)	(0.036)
post vote * xrate impact via imports			-98.19*	-105.3**	-100.6**
			(50.48)	(48.40)	(49.15)
post vote * xrate impact via exports			8.203*	9.857**	9.344**
			(4.238)	(4.070)	(4.260)
post vote * EU national share				0.914	
				(0.804)	
post vote * EU8 national share					0.940
					(1.310)
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.

1.5.8 Financial services results

We now rerun the baseline regressions in Table 3.2 replacing professional services exposure by regional financial services exposure defined in Section 1.3.3.[36] As before, we find negative and significant results across all specifications with coefficients varying from -1.201 to -0.826. Taking column (4) again, we see that a one standard deviation increase in financial services exposure (0.0345) leads to a 3 percent decrease in monthly postings. We again see significant coefficients for the exchange rate impacts, where a one standard deviation increase in import exposure leads to a decrease in postings of 3.4 percent and the same measure for export exposure leads to an decrease of 3.4 percent.

Figure 1.11 displays the coefficients from the regression of log-postings on the financial services exposure measure interacted with quarter dummies. The results are very similar to the professional services case shown in Figure 1.10 with the im-

[36]It should be noted that this regional exposure measure is constructed differently from the breakdown used in Table 1.9, in that it additionally uses regional variation in trade values for identification.

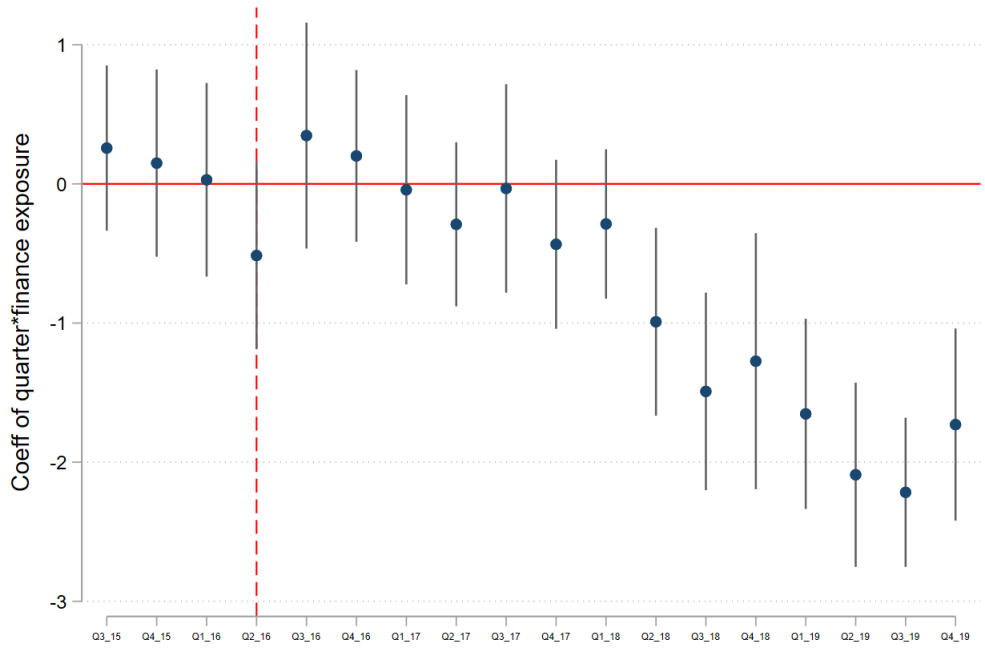


Figure 1.11: Impact of financial services exposure over time

Notes: This graph shows the coefficients from the regressions of the log of monthly job postings on the financial services exposure measure interacted with a dummy variable for each quarter from Q3 2015 to Q4 2019. Coefficients are relative to the base period of Q1 2015 and Q2 2015. The regressions also controlled for the EU immigrant share and the exchange rate measures interacted with the post vote dummy variables, 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 95 percent confidence intervals. The red line shows the quarter when the referendum occurred, Q2 2016.

pact being delayed until Q2 2018, and no effect showing prior to the referendum. Table 1.11 presents the financial services results broken down by skill level. As for professional services, we find that the results are stronger for high skill postings with a one standard deviation increase in exposure leading to a 3.6 percent decrease in postings. The exchange rate impacts are significant as for professional services with small changes in magnitudes.

To understand which specific occupations in this lower skilled group were affected, we further explore the impact on job adverts by UK SOC group. Table 1.12 displays the same regressions run separately for job adverts for each of the nine high level occupation categories, the classification of which is described in Table 2.6 of Section 1.3.5. The coefficient on the FS exposure measure is strongly significant and negative for 5 out of the 9 occupations: *Managers, Directors and*

TABLE 1.11. FINANCIAL SERVICES IMPACT BY SKILL GROUP

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
	Panel (a) High skill				
post vote * FS exposure	-1.414***	-1.414***	-0.989***	-1.043***	-0.996***
	(0.322)	(0.323)	(0.317)	(0.286)	(0.308)
post vote * tariff exposure		0.015	0.021	0.025	0.021
		(0.032)	(0.034)	(0.035)	(0.035)
post vote * xrate impact via imports			-111.6**	-119.0***	-113.5**
			(44.88)	(43.29)	(43.78)
post vote * xrate impact via exports			8.154*	9.900**	9.046**
			(4.159)	(3.979)	(4.213)
post vote * EU national share				0.964	
				(0.822)	
post vote * EU8 national share					0.734
					(1.346)
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 * FS exposure	-0.662**	-0.662**	-0.455*	-0.512**	-0.468*
	(0.275)	(0.274)	(0.262)	(0.237)	(0.249)
post vote * tariff exposure		-0.014	-0.0063	-0.002	-0.006
		(0.037)	(0.039)	(0.038)	(0.039)
post vote * xrate impact via imports			-43.27	-51.25	-46.79
			(51.63)	(49.68)	(50.31)
post vote * xrate impact via exports			7.613	9.489**	9.251*
			(4.750)	(4.618)	(4.775)
post vote * EU national share				1.032	
				(0.775)	
post vote * EU8 national share					1.345
					(1.300)
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.

Senior Officials; *Professional Occupations*; *Associate Professional and Technical Occupations*; *Skilled Trades Occupations*; and *Sales and Customer Service Occupations*. The coefficients range from -1.105 to -0.630 for *Managers, Directors and Senior Officials* and *Sales and Customer Service Occupations* respectively. A one standard deviation increase in financial services exposure then decreases postings for *Managers, Directors and Senior Officials* by 3.8 percent, the next highest coefficient is *Professional Occupations* for which the associated decrease is 3.6 percent.[37]

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. In general, these results suggest that local labour markets that were more exposed to barriers on FS exports reduced the posting of not only high-skilled jobs in the FS industry, but across a range of occupations, suggesting that the impact of FS spilled over to other types of jobs.

1.6 Robustness checks

1.6.1 Excluding London

A primary concern for these results could be that this impact was primarily driven by London, widely considered as the UK's professional services hub. First, Figures 1.4 and 1.5 show that the professional services exposure is actually not as concentrated in London as is often presumed. Additionally, Table 1.17 in Appendix 1.C repeats the analysis in Table 3.2 but excludes the TTWA of London. The resulting coefficients are extremely close to the baseline case with the same levels of significance, allowing us to conclude that London is not driving the results. FS exposure is also spread quite widely across the country, as is shown in Figure 1.15 of Appendix 1.B. Excluding London also does not have much impact on the significance or magnitude of the baseline results for FS exposure.

1.6.2 Including 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

[37] In Table 1.16 of Appendix 1.C, we also provide this analysis for the professional services exposure measure, finding that only the first three occupation groups were affected for professional services.

TABLE 1.12. FINANCIAL SERVICES IMPACT BY OCCUPATION

Dep var: log SOC postings	1. Managers, Directors and Senior Officials	2. Professional Occupations	3. Associate Professional and Technical Occupations
post vote * FS exposure	-1.105***	-1.030***	-0.878***
	(0.327)	(0.305)	(0.326)
post vote * tariff exposure	-0.018	0.059	0.006
	(0.031)	(0.047)	(0.038)
post vote * xrate impact via imports	-90.90*	-180.1***	-105.4**
	(49.14)	(47.15)	(52.70)
post vote * xrate impact via exports	1.741	13.64***	11.22**
	(4.354)	(4.158)	(5.558)
post vote * EU national share	1.133	0.559	1.309
	(0.880)	(0.833)	(0.957)
	5. Skilled Trades Occupations	7. Sales and Customer Service Occupations	4. Administrative and Secretarial Occupations
post vote * FS exposure	-1.004***	-0.630**	-0.365
	(0.313)	(0.291)	(0.292)
post vote * tariff exposure	0.009	-0.034	0.009
	(0.023)	(0.024)	(0.034)
post vote * xrate impact via imports	47.36	-43.75	56.40
	(61.94)	(52.67)	(56.14)
post vote * xrate impact via exports	2.340	2.284	9.635*
	(4.652)	(4.399)	(4.875)
post vote * EU national share	2.526**	1.176	1.309
	(0.969)	(0.918)	(0.951)
	6. Caring, Leisure and Other Service Occupations	8. Process, Plant and Machine Operatives	9. Elementary Occupations
post vote * FS exposure	-0.056	-0.612*	-0.474
	(0.277)	(0.327)	(0.318)
post vote * tariff exposure	0.035	-0.036	0.035
	(0.034)	(0.036)	(0.058)
post vote * xrate impact via imports	-68.27	51.62	23.61
	(51.68)	(61.31)	(59.99)
post vote * xrate impact via exports	18.98***	4.639	5.929
	(4.274)	(6.313)	(5.315)
post vote * EU national share	0.332	2.395**	1.051
	(0.840)	(0.987)	(0.945)
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.

(the 'shift'). We therefore control for these shares for both the professional services measure and the tariff measure. The shares are constructed by a combination of the TTWA-sector employment weightings, and the sectoral exports to employment ratio, i.e excluding the trade weighted STRI or tariff component of the exposure measures.

Table 1.18 in Appendix 1.C repeats the baseline analysis in Table 3.2 but includes these shares. The professional services measure remains significant across all specifications, while the associated share is positive and significant at the 10 percent level in 4 out of the 5 specifications. This suggests that while professional services sectors that exported a lot to the EU were increasing their job postings, those which were more exposed to higher potential trade barriers experienced a relative decline in postings. To interpret the magnitude of the professional services coefficient in this specification, we fix the professional services share at its mean (0.82) and consider a one standard deviation increase in the sectoral STRI exposure (0.058) which leads to a 16 percent relative decline in monthly postings. Both the tariff exposure, and the related share, remain insignificant across specifications, although the exposure is now consistently negative across specifications.

1.6.3 Alternative tariff exposure measures

There are a range of ways in which tariff exposure has been measured in the literature. We additionally consider a number of other formulations of the exposure measure to check robustness. Table 2.9 in Appendix 1.C presents the results for four different exposure measures. Columns (1) and (2) use the 'output weighted' exposure. Instead of weighting by sectoral exports per worker, this measure weights by the fraction of EU exports in total sectoral output.[38] The exposure used in Columns (3) and (4) removes this weighting altogether, leaving a simple export weighted average tariff normalised by neither total employment nor total output. Columns (5) and (6) first take $ln(1 + \text{MFN tariff}_p)$ before applying weightings but otherwise use the same construction as the baseline measure. Finally columns (7) and (8) adapt the baseline by replacing 4-digit national exports by 2-digit regional exports in the weighting.

[38] 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-ouput tables for 2014

The results suggest that these different formulations of the exposure measure do not significantly change the conclusions from the baseline and provide confidence in our result that firms did not appear to be adjusting hiring significantly in response to the threat of potential future MFN tariffs.

1.6.4 Pre-vote placebo

In order to further address the concern that our baseline pre-post results are driven by time varying unobservables that are not absorbed by month-year fixed effects, we conduct a further placebo test. Here we limit the data to only 2015 and split the sample into a pre- and post-period with six months in each. In other words, we introduce a break in mid-2015 instead of using the actual timing of the referendum, which took place in June 2016. We then interact a post-June 2015 dummy with the professional services exposure. Table 2.8 in Appendix 1.C presents the results of this alternative placebo test using pre-referendum postings. The resulting coefficients are not significant across all specifications, suggesting that this impact was not observed prior to the referendum, but driven primarily by the result of the vote.

1.6.5 Goods non-tariff barriers

Although tariffs are the most conspicuous trade barrier for goods, it could be argued that after decades of global negotiations they are reduced to a level which is no longer material for firms in most countries. Perhaps more concerning are the non-tariff barriers (NTBs) to trade in goods, which may remain even if the UK were to sign a free trade agreement with the EU. In order to investigate this possibility we create a new measure of regional exposure to NTBs on exports of goods to the EU.

The measure is constructed is an identical way to the baseline tariff exposure measure but with tariffs replaced by a product-level NTB exposure. We use data from the World Integrated Trade Solution which provides a list of MFN non-tariff barriers at the 8-digit HS level. We first count how many barriers each HS8 product would be exposed to under MFN terms and then take a simple average at the HS6 level to match with our Comtrade export data. This measure is then weighted by

each product's share of exports to the EU before replacing the avg MFN tariff$_{j,2014}$ in equation 2.8.

Table 1.20 presents the results, NTB exposure is not statistically significant in any specification, generally mirroring the results found for the tariff exposure that the threat of barriers on exports of goods does not seem to have had an impact on the posting of job adverts at the local labour market level.

1.6.6 Specific tariffs and quotas

Alongside ad valorem tariffs, calculated as a percentage of the good's value, there are also relevant non-ad valorem tariffs. Two key cases are specific tariffs, computed on the physical quantity of the good being imported, and tariff-rate quotas, made up of a low or zero tariff rate on an initial quantity of imports (the within-quota quantity) and a very high tariff rate on imports entering above that initial amount. Following Crowley et al. (2018a) we use data from WTO Tariff Analysis Online to calculate similar tariff threat measures for the EU MFN specific tariffs and quotas that would be applied under a no deal, specifically creating trade weighted averages of dummies indicating whether a particular product has a specific tariff, a quota, or either of the two.[39] We then include three weighted average measures for each of these three trade barriers as a robustness check on our results.

Table 1.21 presents the baseline results with these measures included. Relative to our baseline result (column (1)) which only considers ad valorem tariffs, the professional services and ad valorem tariff results change very little with the former remaining strongly negative and significant, and the latter insignificant. The specific tariff and quota measures are not significant in any of the specifications confirming the previous results that there is no evidence for the negative impact of the threat of future barriers on goods trade.

1.6.7 UK import tariffs

Although most of the discussion around tariffs centered around the potential impact of EU tariffs on UK exports, there was also some uncertainty concerning possible UK tariffs on imports from the EU under a no deal scenario. We therefore

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

further evaluate whether the threat of these tariffs had any impact on the posting of job adverts. We consider two potential channels.

Exposure to reduced competition through import tariffs

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

$$\text{imp protection}_{j,2014} = \frac{\text{Imports}_{j,2014}}{L_{j,2015}} \times \text{avg MFN tariff}^{(Imp)}_{j,2014} \tag{1.12}$$

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

$$\text{imp protection}_{r} = \sum_{j \in r} \text{empl share}_{jr,2015} \times \text{imp protection}_{j,2014} \tag{1.13}$$

where empl share$_{jr,2015}$ is industry j's share of TTWA r employment.

Exposure to increased cost of imported inputs

Alongside potential protection of UK industries, tariffs may have the additional negative impact of increasing the cost of inputs. If industries typically import inputs which are either not produced by UK firms, or are produced at a higher price,

then the imposition of tariffs on these products would increase costs and potentially reduce production. We calculate this exposure by taking the import protection measure from above and, using UK input-output tables, weighting it by the share this 'input' industry makes up in all of the 'output' industry's imported inputs.[40] Specifically, the measure is calculated as follows:

$$\text{intinputs threat}_{k,2014} = \frac{1}{L_k} \sum_j S_{j,k} \sum_{p \in j} \text{Imports}_p \times \text{MFN tariff}_{p,2014} \tag{1.14}$$

$$\text{intinputs threat}_r = \sum_{k \in r} \text{empl share}_{rk,2015} \times \text{intinputs threat}_{k,2014} \tag{1.15}$$

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

The results for both import tariff measures are presented in Table 1.22. As was the case for the export exposure measure, we find no effect of potential import tariffs on job adverts throughout the negotiation period. Given that we would expect stronger effects for the export exposure measure, as the default no deal tariff schedule was more clearly defined, it is perhaps not all that surprising that we find no effect for these other measures.

1.7 Conclusion

This paper uses data on the near universe of UK online job postings from January 2015 to December 2019 to analyse how the threat of future trade barriers on UK exports of both services and goods to the EU affected labour demand throughout the Brexit negotiation period. We exploit *ex ante* variation in EEA country-sector MFN service trade restrictions relative to restrictions applicable to non-EEA countries to develop measures of local labour market exposure to the threat of no-deal scenario export barriers for professional services exports. We construct an analogous measure for goods exports based on EU MFN tariffs.

We find that the threat of trade barriers on professional services exports to the EU had a strong negative effect on the posting of online job adverts after the Brexit

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

referendum. A one standard deviation increase in local labour market exposure to future professional service export barriers decreased monthly postings by 3.1 percent on average in the post-referendum period. A back-of-the-envelope counterfactual calculation suggests that the aggregate impact of this exposure across all TTWAs implies a cumulative 1.5 million postings lost between July 2016 and December 2019 (for reference, the size of the UK labour force is approximately 31 million). We provide evidence that this negative impact kicked in around Q2 2018 and remained negative for the rest of 2018 and 2019. It is possible that this delayed effect is due to firms taking time to reassess and understand the implications of trade barriers for their operations. Alternatively, these results could reflect the fact that the likelihood of the UK leaving the Single Market and not obtaining mutual recognition of its regulatory regime, and hence facing stringent restrictions on service exports, looked low straight after the vote but increased substantially in late 2017 and the first half of 2018.

In contrast, the threat of future MFN tariffs on goods exports to the EU does not seem to have affected online job adverts during the negotiation period. The same also holds for import tariffs and NTBs on goods exports. We provide a few ideas as to why this may have been the case. While MFN tariffs in some cases can be large, at the HS6 level 63 percent of product lines would have tariffs below 5 percent. These tariffs would cut away at profitability but may not be game-changing in a way that some restrictions on services exports, such as revoking passporting rights, or requiring commercial presence to export engineering or legal services to certain EU countries that were previously major trade partners, could be. One possibility is that these tariffs were simply not a large enough threat to have caused firms to stop hiring prior to being levied. Another explanation could be that there was substantial heterogeneity in how different manufacturing industries were affected. When broken down by subsectors, we discovered that some sectors, such as auto manufacturing, did decrease hiring, but others, such as chemicals, increased hiring. Perhaps only industries hit by tariffs multiple times through global value chains faced substantial enough repercussions to pause hiring. Finally, it could just be that manufacturing represents a relatively small share of UK employment (9.6 percent in 2015) and so impacts on the manufacturing sector may not be large

enough to show up when studying local labour market outcomes.[41]

Given the Brexit negotiation period lasted 3.5 years, we also explore the role of trade policy uncertainty in affecting job postings during this period. We develop two time-varying measures of Brexit-related trade policy uncertainty during this period based on newspaper coverage and Google searches. Additionally, we make use of the Brexit Uncertainty Index from Bloom et al. (2019). Using these indices we show that uncertainty was a key driver of the reduction in postings. We interact our trade barrier exposure measures with these uncertainty measures during the negotiation period and find that the impact of the threat of barriers on exports of professional services was greater in months with heightened uncertainty. Taking the Google index, and fixing the professional services exposure measure at its mean value, an increase in uncertainty during the negotiation period from the 25th to the 75th percentile lead to a 2.8 percent decrease in postings. Using US job postings data to construct a counterfactual for each UK TTWA, we show that such a pattern would not have occurred in the UK, had the UK followed US sectoral trends in online job adverts.

We find that the threat of professional services export barriers only affected the posting of higher skilled job adverts. When broken down into sectoral components, it was the threat of barriers on financial services, engineering, and information service exports that had the biggest impact. We explore the impact of barriers to financial services exports specifically, finding strong negative impacts of exposure to EU-export intensive financial service exports on the posting of job adverts, that affected not only higher-skilled but also lower-skilled job adverts. We show that these results all hold when additionally controlling for other key channels through which the vote could have affected labour demand, including the sharp exchange rate depreciation in the 24 hours following the referendum and immigration policy uncertainty.

We conclude that the threat of future trade barriers on the export of professional services caused by the Brexit referendum had a far greater effect on labour demand than the threat of tariffs on goods exports, despite the greater focus of the

[41] UK total employment data by sector can be found here:
https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/datasets/employmentbyindustryemp13/current

Brexit discourse on manufacturing and tariffs. This impact on job adverts was substantial and indicates that a retreat from trade integration, and particularly deep integration, can have important consequences for labour markets.

Acknowledgements We thank Costa et al. (2019) for sharing their constructed exchange rate variables, and Crowley et al. (2018b) for sharing their NTB variables. We are grateful to Bledi Taska and Layla O'Kane at BGT for their help and support facilitating access to the job postings data. We also thank Abi Adams, Nick Bloom, Steve Bond, Swati Dhingra, Kevin O'Rourke, Ferdinand Rauch, Tom Sampson, Daniel Trefler, Gabriel Ulyssea, Chris Woodruff. David Weinstein, and seminar participants at Oxford, UCL, LSE, FREIT and Villars for insightful comments and feedback.

Appendices of Chapter 1

1.A Comparison of BGT data with other sources

Online job adverts are one indicator of labour demand. The number of job adverts posted online encompasses only a subset of labour demand 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 therefore 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 section, we first evaluate the relationship between BGT online job adverts and another comprehensive measure of labour demand: the estimated number of vacancies from the UK Vacancy Survey.[42]

1. UK Vacancy Survey (UKVS)

The UKVS is a statutory, monthly survey of businesses conducted by the ONS.[43] 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.

[42] The UK Vacancy Survey is limited to national quarterly figures, is based on a significant amount of estimation, and doesn't provide a breakdown by occupations, hence the reason we do not use this data source for the main analysis of the paper.

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

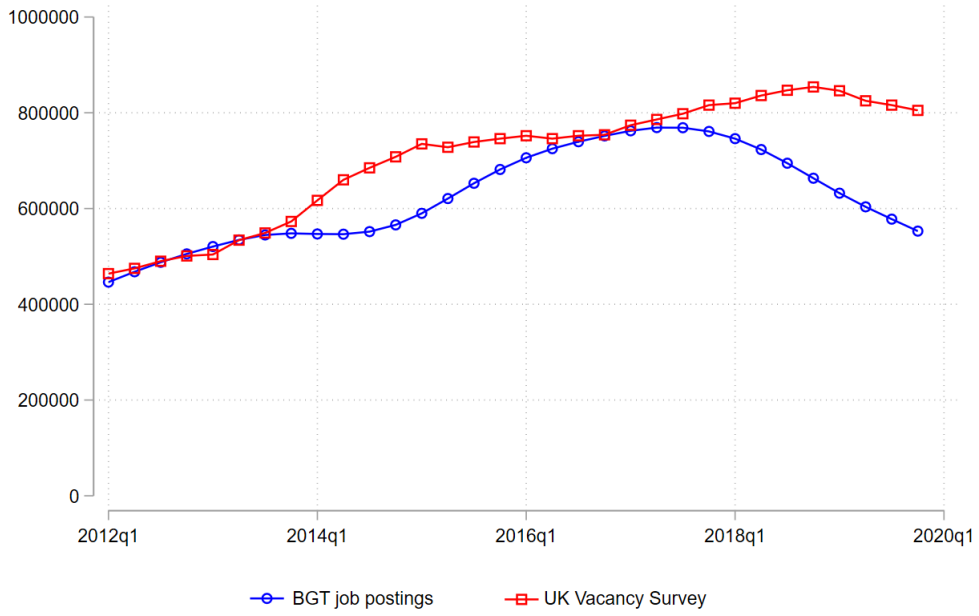


Figure 1.12: Average monthly vacancies: BGT and UK Vacancy Survey

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.

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.[44]

To compare figures from the two sources, we deseasonalise the BGT data and take quarterly averages of the total sum of all postings. Figure 1.12 compares the time series of BGT with the UKVS over the period of 2012-2019. Over this period,

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

BGT covers on average 86% of the total reported in the VS. The monthly average number of postings in the BGT data is very similar to the monthly average number of vacancies reported in the VS 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.

2. ONS Workforce Jobs (WFJ)

We also consider the relationship between labour demand as captured by job adverts and the total number of jobs in the UK economy as measured by the ONS WFJ, which is also affected by labour supply conditions. Vacancies are converted to hires provided the vacancies can be filled. Hires in turn contribute to aggregate job statistics, which additionally depend on the existing number of jobs and firing. The ONS provides a quarterly measure of the estimated total number of jobs in the UK, defined as the sum of employee jobs measured primarily by employer surveys, self-employment jobs from the Labour Force Survey (LFS) and government-supported trainees and Her Majesty's Forces (HMF) from administrative sources.[45] The definition of an employee is anyone working on a specific date who is aged 16 years and over, that is paid in return for carrying out a full-time or part-time job or being on a training scheme. Private sector employee jobs are obtained from Short-Term Employer Surveys (STES), which are conducted with approximately 32,800 businesses per quarter. The Quarterly Public Sector Employment Survey (QPSES) measures public sector employment and is conducted with 1500 contributors per quarter. The LFS surveys 50,000 households per quarter.

[45]https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/methodologies/workforcejobsqmi

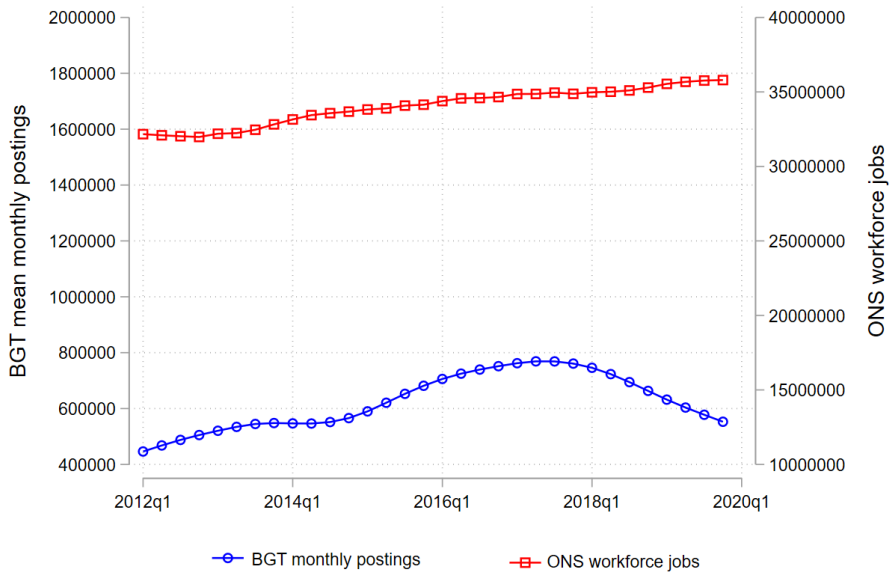


Figure 1.13: BGT average monthly vacancies and ONS average monthly jobs

Notes: This figure compares the seasonally adjusted average monthly number of workforce jobs from the ONS workforce jobs survey. We deseasonalise the BGT data using the Hodrick–Prescott high-pass filter.

Over the period of 2012-2019 the median number of workforce jobs was 34 million. The average ratio of monthly vacancies from the UKVS to the total number of workforce jobs was 2%, while the ratio of job postings from BGT to the total number of workforce jobs was 1.8%. Figure 1.13 displays the total number of jobs over time, compared to the monthly average number of BGT postings over time for each quarter. The number of workforce jobs has steadily increased from 2012 to 2019 and experienced no dip after the referendum.

There are a number of reasons why the WFJ estimates might not have demonstrated a decline after the referendum. If firms do not hire, but also do not fire, then we would not expect the total number of jobs to decrease. This could have been the case after the referendum: due to the uncertainty about future policy, firms and workers may have been unwilling to hire and fire, or leave and search for new jobs. Another possibility is that these statistics also rely on imputation for non-responsive and non-sampled firms and workers and so could be less responsive in times of downturn or uncertainty.

1.B Additional maps and figures

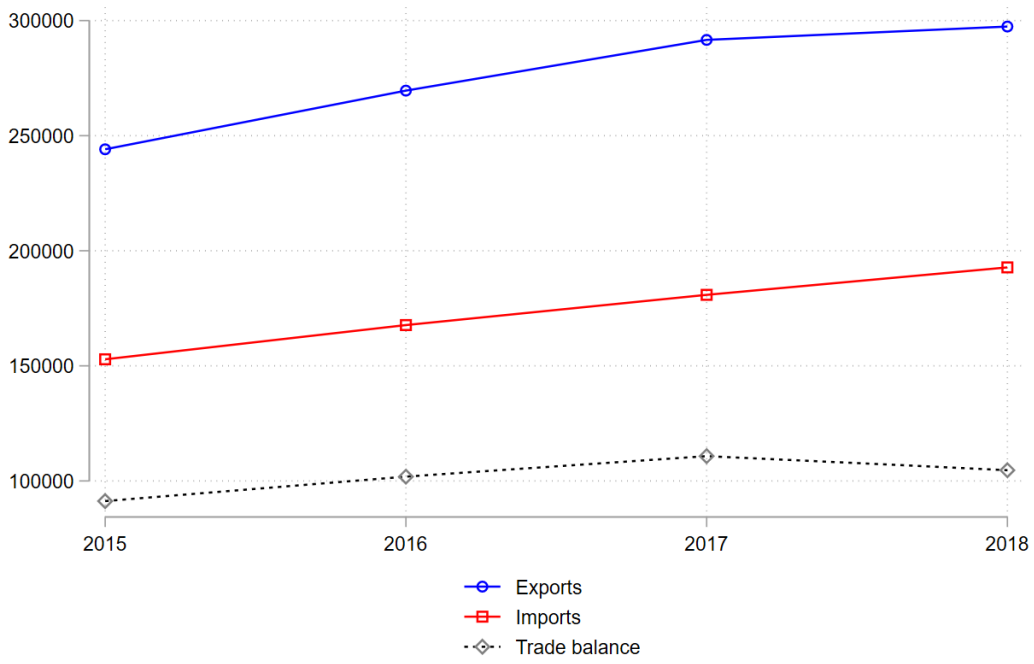


Figure 1.14: UK total trade in services in £millions

Notes: This figure shows the UK's total exports and imports of services, by year, in millions of pound sterling, taken from the UK's Pink Book 2019.

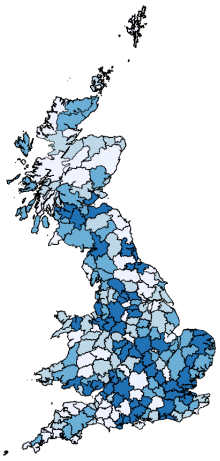


Figure 1.15: Financial service exposure map

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

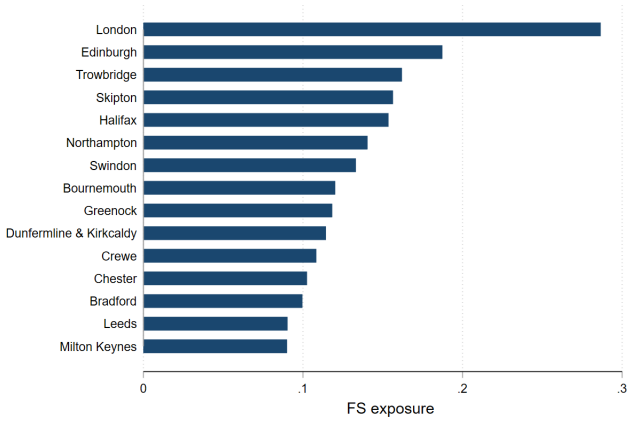
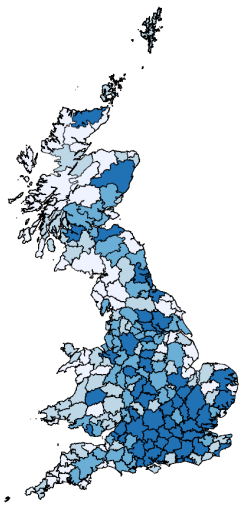
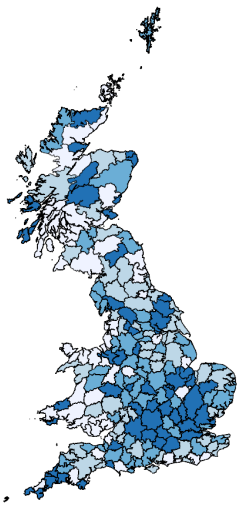


Figure 1.16: Most exposed TTWAs: financial services

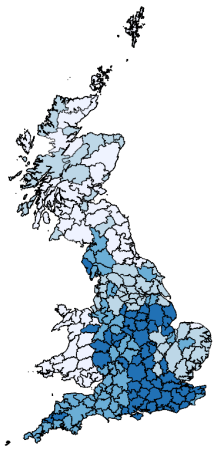
Notes: This chart presents the employment-weighted financial services exposure measures for the top 15 most exposed TTWAs.



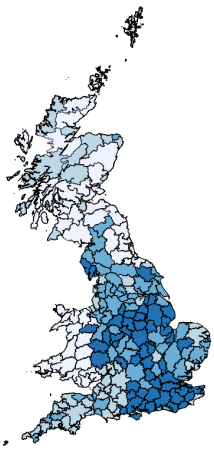
(a) Exposure to more expensive imports



(b) Exposure to cheaper exports



(c) EU national employment share



(d) EU8 national employment share

Figure 1.17: Exposure to the exchange rate depreciation and immigration

Notes: Panel (a) displays the measure of exposure to the impact of the exchange rate depreciation on the price of intermediate imports. Areas with darker blue had a higher employment share in 2015 in sectors more affected by higher cost imports. Panel (b) displays the measure of exposure to the impact of the exchange rate depreciation on the price of exports. Areas with darker blue had a higher employment share in 2015 in sectors with more competitive export prices after the vote. Panel (c) displays the 2015 employment share of EU nationals, areas with darker blue had a higher share. Panel (d) displays the share of EU8 nationals, areas with darker blue had a higher share.

1.C Additional tables

TABLE 1.13. MAPPING BETWEEN UK SIC, OECD STRI & ONS SERVICE EXPORT PRODUCT TYPES

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

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

TABLE 1.14. US PLACEBO FOR FINANCIAL SERVICES

Dep variable: log US postings	(1)	(2)	(3)	(4)	(5)	(6)
	Google		Newspaper		BUI	
measure* FS exposure	-0.010	-0.012	-0.011	-0.010	-0.003	-0.004
	(0.036)	(0.034)	(0.016)	(0.015)	(0.004)	(0.004)
measure *tariff exposure	-0.001	-0.001	-0.000*	-0.000**	-0.000	-0.000
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
measure*EU national share	-0.032		0.005		-0.010	
	(0.055)		(0.034)		(0.007)	
measure*EU8 national share		-0.054		-0.003		-0.018
		(0.083)		(0.050)		(0.011)
Observations	8,520	8,520	8,520	8,520	8,520	8,520
Adjusted R-squared	0.994	0.994	0.994	0.994	0.994	0.994
TTWA FE	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 various uncertainty measures. The period September 2016 to December 2019 is covered. 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 1.15. UNCERTAINTY MEASURES WITH QUARTERLY TREND CONTROLS

Dep varable: log postings		Google			Newspaper			BUI	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
post vote*measure*	-0.172***	-0.184**	-0.044***	-0.060***	-0.038	-0.026***	-0.013***	-0.041***	-0.007**
prof service exposure	(0.047)	(0.079)	(0.016)	(0.022)	(0.033)	(0.009)	(0.003)	(0.008)	(0.008)
post vote*		0.049			-0.174			1.448***	
prof service exposure		(0.218)			(0.206)			(0.362)	
post vote*measure*	0.009	0.009	0.009	0.006	0.006	0.006	0.001	0.001	0.001
tariff exposure	(0.009)	(0.009)	(0.009)	(0.005)	(0.004)	(0.004)	(0.001)	(0.001)	(0.001)
post vote*	-57.46	-61.02	-61.05	-76.47	-64.74	-64.16	-34.05	-64.42	-64.85
xrate impact via imports	(50.61)	(51.41)	(51.21)	(50.17)	(51.05)	(50.92)	(51.32)	(50.50)	(50.46)
post vote*	6.335	6.409	6.409	7.590*	7.345*	7.333*	6.464	7.162*	7.172*
xrate impact via exports	(4.039)	(4.033)	(4.034)	(3.997)	(3.999)	(3.999)	(4.159)	(4.102)	(4.106)
post vote*measure*	-0.469*	-0.465*	-0.465*	-0.124	-0.131	-0.131	-0.0178	-0.0150	-0.0150
EU national share	(0.253)	(0.252)	(0.253)	(0.124)	(0.124)	(0.124)	(0.019)	(0.019)	(0.019)
Post vote quarters * prof serv exposure	No	No	Yes	No	No	Yes	No	No	Yes
Observations	12,780	12,780	12,780	12,780	12,780	12,780	12,780	12,780	12,780
Adjusted R-squared	0.984	0.984	0.985	0.984	0.984	0.985	0.984	0.985	0.985
TTWA FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year-month FE	YES	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 various uncertainty measures. The quarterly interactions represent the dummies for each specific post-referendum quarter, where Q1 is the third quarter of 2016, interacted with the professional service exposure measure. 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 1.16. PROFESSIONAL SERVICE EXPOSURE 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 * prof services exposure	-0.398***	-0.502***	-0.309*
	(0.148)	(0.140)	(0.162)
post vote * tariff exposure	-0.0222	0.0542	0.00262
	(0.0311)	(0.0456)	(0.0383)
post vote * xrate impact via imports	-66.52	-137.8***	-87.23
	(54.16)	(46.64)	(56.03)
post vote * xrate impact via exports	0.883	12.45***	10.56*
	(4.343)	(4.105)	(5.603)
post vote * EU national share	0.792	0.217	1.039
	(0.863)	(0.805)	(0.963)
	4. Administrative and Secretarial Occupations	5. Skilled Trades Occupations	6. Caring, Leisure and Other Service Occupations
post vote * prof services exposure	-0.0420	-0.286*	0.0261
	(0.152)	(0.165)	(0.128)
post vote * tariff exposure	0.00805	0.00538	0.0346
	(0.0344)	(0.0242)	(0.0336)
post vote * xrate impact via imports	51.05	58.14	-73.94
	(61.15)	(67.99)	(54.85)
post vote * xrate impact via exports	9.613*	1.782	19.07***
	(4.915)	(4.736)	(4.291)
post vote * EU national share	1.213	2.229**	0.323
	(0.962)	(0.989)	(0.818)
	7. Sales and Customer Service Occupations	8. Process, Plant and Machine Operatives	9. Elementary Occupations
post vote * prof services exposure	-0.144	-0.266	-0.254
	(0.145)	(0.160)	(0.159)
post vote * tariff exposure	-0.0361	-0.0390	0.0327
	(0.0244)	(0.0365)	(0.0577)
post vote * xrate impact via imports	-42.19	71.86	46.57
	(54.39)	(65.94)	(62.75)
post vote * xrate impact via exports	2.035	4.032	5.316
	(4.440)	(6.359)	(5.353)
post vote * EU national share	0.996	2.197**	0.889
	(0.921)	(1.025)	(0.926)
Observations	12,780	12,780	12,780
TTWA FE	YES	YES	YES
Month-Year FE	YES	YES	YES

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

TABLE 1.17. BASELINE EXCLUDING LONDON

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * prof service exposure	-0.539***	-0.541***	-0.355***	-0.340**	-0.346**
	(0.135)	(0.135)	(0.125)	(0.130)	(0.132)
post vote * tariff exposure		-0.008	0.001	0.003	0.001
		(0.033)	(0.035)	(0.035)	(0.035)
post vote * xrate impact via imports			-74.38	-81.50	-76.98
			(52.61)	(49.95)	(50.52)
post vote * xrate impact via exports			7.904*	9.181**	8.574*
			(4.191)	(4.114)	(4.296)
post vote * EU national share				0.703	
				(0.953)	
post vote * EU8 national share					0.540
					(1.399)
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 1.18. INCLUDING SHARES

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * prof service exposure	-4.287**	-4.216**	-3.285*	-3.432*	-3.299*
	(1.972)	(1.974)	(1.764)	(1.755)	(1.750)
post vote * prof services emp & export share	0.544*	0.534*	0.419	0.441*	0.422*
	(0.284)	(0.285)	(0.251)	(0.250)	(0.249)
post vote * tariff exposure		-0.032	-0.021	-0.020	-0.021
		(0.060)	(0.060)	(0.060)	(0.061)
post vote * manu emp & exp sh		0.001	0.001	0.001	0.001
		(0.002)	(0.002)	(0.002)	(0.002)
post vote * xrate impact via imports			-50.49	-57.74	-53.42
			(54.59)	(52.82)	(52.97)
post vote * xrate impact via exports			7.284*	8.727**	8.051*
			(4.193)	(4.081)	(4.300)
post vote * EU national share				0.788	
				(0.788)	
post vote * EU8 national share					0.614
					(1.331)
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 1.19. ALTERNATIVE TARIFF MEASURES

	Output weighted		Export weighted		Logged tariffs		Regional export weighted	
Dep variable: log postings	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
post vote * prof service exposure		-0.338***		-0.345***		-0.337***		-0.325**
		(0.124)		(0.128)		(0.124)		(0.124)
post vote * tariff exposure	9.830	12.66	4.416	0.498	10.34	13.47	0.000	0.000*
	(18.09)	(19.21)	(7.898)	(9.710)	(19.11)	(20.18)	(0.000)	(0.000)
post vote * xrate impact via imports		-81.68		-80.78		-81.75		-82.25
		(49.71)		(53.22)		(49.68)		(49.56)
post vote * xrate impact via exports		9.458**		9.067**		9.462**		10.04**
		(4.024)		(4.232)		(4.024)		(3.893)
post vote * EU national share		0.655		0.630		0.655		0.667
		(0.797)		(0.802)		(0.797)		(0.791)
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 1.20. GOODS NON-TARIFF BARRIERS

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * prof service exposure	-0.538***	-0.531***	-0.339***	-0.336**	-0.335**
	(0.132)	(0.139)	(0.126)	(0.126)	(0.129)
post vote * tariff exposure		-0.017	-0.013	-0.010	-0.012
		(0.036)	(0.036)	(0.035)	(0.036)
post vote * goods NTBs		0.069	0.117	0.104	0.108
		(0.166)	(0.175)	(0.172)	(0.173)
post vote * xrate impact via imports			-71.45	-77.93	-73.39
			(53.59)	(51.49)	(51.71)
post vote * xrate impact via exports			8.467*	9.477**	8.862**
			(4.269)	(4.178)	(4.324)
post vote * EU national share				0.573	
				(0.770)	
post vote * EU8 national share					0.348
					(1.303)
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 1.21. SPECIFIC TARIFFS AND QUOTAS

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * prof service exposure	-0.346***	-0.315**	-0.368***	-0.332**	-0.357***
	(0.124)	(0.129)	(0.125)	(0.129)	(0.124)
post vote * ad val tariff exposure	0.003	-0.027	-0.000	-0.037	0.001
	(0.035)	(0.044)	(0.035)	(0.046)	(0.035)
post vote * quota exposure		0.112		0.134	
		(0.140)		(0.155)	
post vote * specific tariff exposure			-1.838	-1.998	
			(1.316)	(1.289)	
post vote * quota or specific tariff exposure					-3.053
					(1.927)
post vote * xrate impact via imports	-81.092	-73.955	-107.184*	-100.899*	-108.547*
	(50.310)	(49.313)	(55.575)	(53.366)	(54.881)
post vote * xrate impact via exports	9.084**	9.690**	7.931*	8.557**	7.695*
	(4.065)	(4.086)	(4.283)	(4.230)	(4.264)
post vote * EU national share	0.639	0.637	0.837	0.851	0.733
	(0.797)	(0.798)	(0.777)	(0.777)	(0.791)
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 1.22. IMPORT PROTECTION AND IMPORTED INPUTS

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post vote * prof service exposure				-0.337***	-0.333**
				(0.125)	(0.129)
post vote * intermediate import tariff exposure	-0.024		0.082	0.105	0.093
	(0.124)		(0.216)	(0.206)	(0.201)
post vote * import protection tariff exposure		-0.008	-0.054	-0.047	-0.045
		(0.017)	(0.035)	(0.034)	(0.034)
post vote * export tariff exposure			0.072	0.063	0.059
			(0.062)	(0.062)	(0.062)
post vote * xrate impact via imports				-82.73	-78.34
				(49.81)	(50.21)
post vote * xrate impact via exports				9.183**	8.693**
				(4.112)	(4.300)
post vote * EU national share				0.726	
				(0.790)	
post vote * EU8 national share					0.701
					(1.285)
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 1.23. PRE-VOTE PLACEBO FOR 2015

Dep variable: log postings	(1)	(2)	(3)	(4)	(5)
post June '15 * prof service exposure	-0.037	-0.027	-0.068	-0.081	-0.082
	(0.176)	(0.172)	(0.150)	(0.151)	(0.156)
post June '15 * tariff exposure		0.044	0.065	0.058	0.064
		(0.040)	(0.038)	(0.035)	(0.038)
post June '15 * import appreciation			58.58	76.93	63.54
			(63.95)	(60.74)	(59.90)
post June '15 * export depreciation			14.03**	10.86*	12.79**
			(5.734)	(5.033)	(5.264)
post June '15 * EU national share				-1.696	
				(1.152)	
post June '15 * EU8 national share					-0.988
					(1.999)
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.

CHAPTER 2

Local Labour Market Effects of the US Trade War

Abstract This paper uses high frequency data on the near universe of job adverts posted online in the United States to study the impact of the 2018 tariff increases on labour demand. I develop measures of local labour market exposure to these tariffs which capture three mechanisms: protection of US industries, increases in the cost of imported inputs for US producers, and exposure of US exporters to retaliatory tariffs. I find that commuting zones that were more exposed to tariffs on imported inputs and to retaliatory tariffs saw a differential decline in online job adverts in 2018, and these effects were stronger for low skill postings than for high skill postings. I also find that the US agricultural subsidies announced under the Market Facilitation Program may have increased job postings, but there is no evidence that they particularly benefited commuting zones that were more exposed to the negative effects of the retaliatory tariffs.

2.1 Introduction

There has been a significant recent literature discussing some of the potential negative consequences of increased global integration (Topalova (2010), Edmonds et al. (2010), etc.), particularly in the context of the rise of China as a major global economy and exporting powerhouse (Autor et al. (2013), Autor et al. (2014), Pierce and Schott (2016)). After many decades of reductions in trade barriers, 2018 saw a sharp reversal of this trend with the US unilaterally increasing tariffs on numerous products imported from a large range of countries, and affected countries following suit with retaliatory tariffs on US exports.

This period provides a unique opportunity to study the consequences of reintroducing large trade barriers between highly integrated economies. Throughout his mandate, President Trump has expressed a clear focus on US jobs and their link with trade policy, as evidenced by statements during his inaugural address such as 'one by one, the factories shuttered and left our shores, with not even a thought about the millions upon millions of American workers left behind' and promising that 'we will bring back our jobs.'[1] This paper aims to speak to this stated goal by examining the short-run impacts of the 2018 tariff changes on US labour demand, as proxied by the number of online job postings published during this period. The analysis constructs measures of local labour market exposure to tariffs introduced in 2018 based on the pre-trade war industry composition of US commuting zones. It focuses on three channels: protection of US companies with respect to competing imports from abroad; the increasing cost of imported inputs faced by US companies; and retaliatory tariffs imposed by foreign countries on US exports.

The events of 2018 were exceptional in that it had been decades since such a large, high income economy had raised tariffs on trading partners to such an extent. The degree to which countries have become economically entangled, as well as the reduced hegemony of the US relative to the EU and China, make tariff increases increasingly risky for the imposing country. Furthermore, the founding of the World Trade Organization (WTO) in 1995 started to cement the global rules-based system for trade, providing an official forum to which countries could bring

[1] https://www.whitehouse.gov/briefings-statements/the-inaugural-address

their trade disputes without resorting to unilateral action. However, the significant unilateral action of the United States and the retaliatory actions from its trading partners, as well as the weakening of the WTO through the ending of the Appellate Body, risk signifying the start of a breakdown of the rules-based system. This paper therefore contributes to a wider effort to understand the consequences of these actions and in particular the potential costs of this breakdown for global prosperity.

This paper investigates the impact of time-varying tariff exposure on online job postings at the US commuting zone level. The job postings data used is scrapped from tens of thousands of websites, and represents the near universe of online job postings in the US, as well as being available at almost real-time and providing information on the location and occupation of the job described in the online advert. Employment figures, in contrast, are published with a greater delay and result from the interaction of both supply and demand, whereas job postings represent a more proximate measure of labour demand. I adopt a shift-share approach, first calculating per worker national sectoral exposure to tariffs based on product-level tariffs, pre-sample trade flows, and sectoral employment levels. These sectoral measures are then weighted by the commuting zones' initial industry employment composition to generate time-varying, commuting zone specific exposures. There are three main exposure measures calculated to account for the three channels of potential impact of tariffs on job postings. The first maps product-level US import tariffs to their sectors of production, providing a measure of the increase in protection against foreign competition that this sector enjoys (output tariff exposure). The second adds an additional layer, passing the import protection through an input-output matrix to measure the exposure of downstream US industries to the increased cost of imported inputs (input tariff exposure). The third instead focuses on the retaliatory tariffs levied by third-countries on US exports, capturing the exposure of US industries to tariffs on their products (export tariff exposure). A priori, standard trade theory would predict a direct producer surplus due to protectionism which would likely translate into firm expansion and hence increased job postings. It would also predict that firms would be harmed by the increased cost of intermediate inputs as well as by foreign tariffs on US exports.

Although the lists of targeted tariffs were typically released ahead of implementation, significant uncertainty surrounded the specific dates, products and source countries which would end up being affected by the changes. Products were added and removed from the lists up until the last minute, and there was a perception that progress in negotiations could pause or even annul planned increases. I therefore argue that at best my results effectively capture the impact of the tariff changes, and at worst represent a lower bound effect if firms were to adjust hiring in advance of the actual changes.

The baseline results show that both the export and input tariff exposures have a consistently negative impact on job postings, while the impact of output tariff exposure is not significant once imported input tariffs are controlled for. Specifically, a one standard deviation increase in input tariff exposure led to a 3.6 percent decrease in hiring, and a one standard deviation increase in export tariff exposure led to a 7.3 percent decrease in hiring. These results provide evidence, therefore, of an overall negative impact on labour demand due to the 2018 tariff increases. A back-of-the-envelope counterfactual calculation shows that these effects were concentrated in the second half of 2018 as the tariffs started to build up, and led to a estimated combined effect of 175,115 fewer job postings (of which 121,571 were due to imported inputs and 53,544 due to exports). The lost postings represent a 0.6 percent decrease for the whole of 2018 and a 0.9 percent decrease for the second half of the year.

I additionally control for the US agricultural subsidies announced in July 2018 as a response to the retaliatory tariffs, finding some evidence for a positive impact but no evidence that the subsidies were more effective in commuting zones that were more exposed to the retaliatory tariffs. I then separate the baseline results by high and low skill postings, finding that both are affected in a similar way to aggregate postings, but that the effect is stronger for low skill jobs. Finally I conduct robustness exercises, including a pre-sample placebo test and using various alternative constructions of the exposure measures, both of which support the baseline results.

This paper contributes to a burgeoning literature focusing on the recent retreat from globalisation, both in the form of the widespread tariff increases in 2018 and

the UK leaving the European Union. A detailed overview of the US Trade War timeline is provided by Bown and Kolb (2019), and Crowley, ed (2019) presents a discussion of key elements of the conflict, including its origins, costs, and the challenges it poses for the future.

There are several prominent recent papers analysing the price impact of the 2018 tariffs including Amiti et al. (2019), Cavallo et al. (2019), Fajgelbaum et al. (2020), and Flaaen et al. (2020). These papers have found a very high or near complete pass through of US import tariffs onto US import prices, although results on the effect of retaliatory tariffs on US export prices is more mixed: Amiti et al. (2019) and Fajgelbaum et al. (2020) find no reduction in prices, and Cavallo et al. (2019) find reductions for products that are less differentiated. Cavallo et al. (2019) also find that the US import tariffs were not fully incorporated into retail prices, perhaps due to reduced retailer markups, or due to a delayed effect coming from a pre-tariff increase in imports. In all cases, tariffs seem to have reduced both import and export quantities due to the resulting increased consumer prices in the US and abroad. These results all point to mechanisms through which the incidence of the tariffs could affect US producers: consumer prices increased which may lead to a degree of protection for domestic producers; prices of intermediate inputs also increased which may make production more expensive for certain domestic producers; and there was a reduced demand for US exports abroad. My paper addresses how these factors fed through into labour demand, a key policy objective of the Trump administration.

Several papers also look at the impact of the tariff increases at the local level. Blanchard et al. (2019) provide evidence on the relationship between county-level tariff exposure and votes in the 2018 congressional election, finding that Republican candidates lost support in counties that were more exposed to tariff retaliation. They also found that this effect was partially mitigated by agricultural subsidies announced in the summer of 2018. I make use of a similar regional exposure measure, but include the effects of import tariffs and retaliatory tariffs, as well as focusing on commuting zones which are the more natural unit of analysis for labour market outcomes. My results may provide some insight into a potential intermediate explanation for the reduction in political support: a reduction in the ease of

finding a job due to decreased online job postings. Fajgelbaum et al. (2020) also conduct county-level analysis, with their model finding that tradeable sectors in heavily Republican counties experienced the largest losses in real wages.

Perhaps the most related existing paper is Flaaen and Pierce (2019), who investigate the sectoral impact of the trade war on manufacturing employment, output, and producer prices. The authors also concentrate on the three channels discussed above and use monthly national employment data, finding that moving from the 25th percentile to the 75th percentile in industry exposure to each of the three channels of tariffs is associated with a 1.4 percent reduction in manufacturing employment. My paper contributes a number of unique elements: I aim to get closer to a measure of labour demand rather than estimated employment by using the job postings data, which also has the advantage of being broken down by occupation and skill level; the analysis is run at the local labour market level and is not just limited to the manufacturing sector; and I use actual monthly changes in tariffs to calculate exposure rather than just the aggregate proportion of trade affected over the whole period.[2]

Finally, this paper adds 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 (2020); Deming and Kahn (2018)), and builds on the related analysis presented in Chapter 1 of this thesis.

The paper proceeds as follows: Section 2 provides background information on the trade war, Section 3 summarises the data sources used and construction of the exposure measures, Section 4 outlines the empirical strategy, Section 5 presents the results, Section 6 the robustness checks, and Section 7 concludes.

2.2 Background on 2018 tariff increases

This paper focuses on the tariffs introduced in 2018, both by the US on imports from various partners, as well as by these partners on US exports. Table 2.1 displays a summary of the timeline for the introduction of tariffs.[3] This section aims

[2] Additionally, Waugh (2019) concentrates specifically on the retaliatory Chinese tariffs and provides estimates of the impact on county-level retail employment, finding a 0.75 percentage point decline in retail employment growth for high tariff counties relative to low tariff counties.

[3] As summarised by Fajgelbaum et al. (2020).

to provide a broad overview of the timing and content of the tariff changes; a more detailed account is provided by Bown and Kolb (2019).

The World Trade Organisation (WTO), and before it the General Agreement on Tariffs and Trade (GATT), was introduced to provide a rules-based system for international trade, which resulted in dramatic decreases in tariff barriers and greater predictability in global trade policy. The GATT followed a period of intense protectionism during the Great Depression, typified by the United States Smoot-Hawley Tariff Act of 1930 which raised tariffs on over 20,000 imported goods and is widely considered to have exacerbated the Great Depression (Whaples (1995)). The WTO provided a forum to which countries could bring their complaints about unfair trade policy of other nations, and provided a framework, including the Most Favoured Nation (MFN) principle and bound tariff rates, which aimed to minimise the risk of tit-for-tat trade wars in which all countries could end up worse off.

The recent increase in nationalist political sentiment, exemplified by both the United Kingdom's decision to leave the European Union and the United States' large increases in tariff rates, as well as the weakening of the WTO which culminated in the suspended functioning of the Appellate Body in December 2019, have dramatically shifted the trend of increased global integration. The unilateral actions of the US, for which the dispute resolution mechanisms of the WTO were largely sidelined, led to a fast ramping up of tariffs which were product and source country specific. In order to justify these actions, the US relied on a number of relatively infrequently used articles within US trade law such as those relating to a 'national security threat' and 'global safeguards', discussed in more detail below.[4]

It is important to note that 2018 was a period of great uncertainty for importers and exporters in the US. Although lists of targeted tariff lines were typically announced in advance of the actual change, these lists were frequently subject to substantial modifications in terms of the specific products included, the rates that

[4]Section 201 of the Trade Act of 1974 allows protection if an import surge is a substantial cause of serious injury to an industry (invoked for tariffs on imported washing machines and solar panels). Section 232 of the Trade Expansion Act of 1962 allows the United States to impose tariffs when imports threaten to impair national security (invoked for imposing tariffs on imported steel and aluminum). Section 301 of the Trade Act of 1974 allows for protection if a trading partner is deemed to have violated a trade agreement or engages in unreasonable practices that burden US commerce (invoked for tariffs on US imports from China).

TABLE 2.1. TIMELINE OF TARIFF INCREASES

Tariff wave	Date enacted	Products	2017 imports		Tariff (%)	
		(# HS-10)	(mil US$)	(%)	2017	2018
Panel A: Tariffs on U.S. imports enacted by the United States in 2018						
Solar panels	7th Feb, 2018	8	5,782	0.2	0	30
Washing machines	7th Feb, 2018	8	2,105	0.1	1.3	32.2
Aluminum	Mar–Jun, 2018	67	17,685	0.7	2	12
Iron and steel	Mar–Jun, 2018	753	30,523	1.3	0	25
China 1	6th July, 2018	1,672	33,510	1.4	1.3	26.2
China 2	23rd Aug, 2018	433	14,101	0.6	2.7	27
China 3	24th Sep, 2018	9,102	199,264	8.3	3.3	12.9
Total		12,043	302,970	12.7	2.6	16.6
Panel B: Retaliatory tariffs on U.S. exports enacted by trading partners in 2018						
China	Apr–Sep, 2018	7,474	92,518	6	8.4	18.9
Mexico	5th Jun, 2018	232	6,746	0.4	9.6	28
Turkey	21st Jun, 2018	244	1,554	0.1	9.7	31.8
European Union	22nd Jun, 2018	303	8,244	0.5	3.9	29.2
Canada	1st July, 2018	325	17,818	1.2	2.1	20.2
Russia	6 Aug, 2018	163	268	0	5.2	36.8
Total		8,073	127,149	8.2	7.3	20.4

Notes: Reproduced based on Fajgelbaum et al. (2020). Panels display unweighted monthly 10-digit HS country average tariff rates. 2017 tariff rates computed as annual average; 2018 rates computed in December 2018. Total tariff rates represent trade-weighted average of row values. Import/export share denominator is total 2017 annual US$ value of all U.S. imports/exports. US government announced import tariffs on aluminum and steel on March 23 but granted exemptions for Mexico, Canada, and the EU which were later lifted on 1st June. Chinese retaliation dates are 6th April, 2nd July, 23rd August, and 24th September.

those products would face, and which countries would be affected/exempt. Moreover, negotiations were ongoing throughout the period with the aim of halting any future increases in tariffs on both sides, and there were several occasions where changes were delayed or halted at the last minute (see below for examples). The result of this was that firms would have been unable to predict any extra costs/benefits they might experience with any certainty until the actual day of tariff implementation. This is important for the estimation of the effects of tariffs on job postings as discussed in the Empirical Specification Section.

Following Bown and Kolb (2019), I split the trade disputes and associated tariff changes into three key 'battles': solar panel and washing machines; steel and aluminium; and unfair trade practices for technology and intellectual property. I discuss each one in turn in the following subsections.

2.2.1 Solar panel and washing machine import tariffs

In response to two industries' requests for investigation under Section 201 of the Trade Act of 1974, President Trump imposed safeguarding tariffs on $1.8 billion in imports of washing machines, and on $8.5 billion in imports of solar panels on the 22nd January 2018. This was followed, on the 5th February, by China launching anti-dumping and countervailing duty investigations into US exports of sorghum. Although not explicitly retaliatory in nature, the timing implies a link with the US tariff increases. China went on to initiate anti-dumping duties of 178.6 percent on its imports of sorghum from the US, and South Korea followed by filing a dispute at the WTO on the 14th May. On the 18th May, following negotiations between the US and China, China announced the end of their sorghum tariff increases. However, later in the year (14th August 2018), China joined South Korea in filing a dispute at the WTO against US solar panel tariffs.

2.2.2 Steel and aluminium tariffs

On the 20th April and 27th April 2017, President Trump asked the Commerce Secretary to initiate investigations into steel and aluminium imports, with a focus on their threat to US national security (Section 232 of the Trade Expansion Act of 1962). On the 16th February 2018, the Department of Commerce concluded that these imports do indeed threaten national security, despite the fact that the vast majority of the imports are sourced from allies such as Canada, the European Union, Mexico, and South Korea. Forthcoming tariffs of 25 percent on steel and 10 percent on aluminium on all trading partners were announced by the US on the 1st March. In response, on the 7th March, the EU threatened to file a WTO dispute, as well as to introduce 25 percent tariffs on a precisely targeted $3.4 billion of imports from the US including cranberries, Harley Davidson motorcycles, blue jeans, and bourbon.

President Trump temporarily exempted Canada and Mexico from the forthcoming tariffs on the 8th March, whilst waiting to assess the results of the NAFTA renegotiation. This was followed on the 22nd March by exemptions for the EU, South Korea, Brazil, and Australia effective until the 1st May 2018. The steel and aluminium tariffs (25 percent and 10 percent respectively) on the remaining non-exempt countries then went into effect on the 23rd March, with no clear guidance

for if, how or when the tariffs would be removed. Five days later, on the 28th March, South Korea received a permanent exemption from the steel tariffs in exchange for capping its steel exports at a 21.2 percent reduction from 2017 levels.

On the 2nd April, China retaliated by imposing tariffs on US exports of products such as aluminium waste and scrap, pork, and fruits and nuts totalling $2.4 billion in 2017 export value (as compared to US tariffs covering $2.8 billion of Chinese exports).

At the last minute, on the 30th April, the US extended the tariff exemptions for the EU, Canada and Mexico until the 1st June 2018 but not for South Korea's aluminium exemption. Indefinite exemptions were awarded to Argentina, Australia and Brazil while finalising 'alternative means' to address the issue of national security. On the 1st June, tariff exemptions for the EU, Canada and Mexico finally ended leading to the imposition of 25 percent on steel and 10 percent on aluminium. Argentina agreed to quotas on both metals whilst Brazil agreed to quotas on steel but faced a 10 percent tariff on aluminium. The only country not facing restrictions at this point was Australia.

In retaliation, on the 22nd June the EU implemented tariffs on $3.2 billion of US exports from the initial list defined on the 7th March, with steel and aluminium making up about a third of this value. On the 1st July, Canada also retaliated with tariffs on $12.8 billion of US exports covering steel and aluminium, as well as a range of agricultural goods and consumer goods. The US went on to escalate the exchange on the 16th July by filing disputes at the WTO challenging the tariffs levied by Canada, China, the EU, Mexico, and Turkey.

In order to compensate American farmers for lost export sales resulting from what the US Department of Agriculture termed 'unjustified retaliatory tariffs', the US administration announced agricultural subsidies worth up to $12 billion on the 24th July.[5]

In response to the depreciation of the Turkish Lira, on the 10th August President Trump announced an increase from 25 percent to 50 percent on the steel tariff faced by Turkey, along with an increase from 10 percent to 20 percent for

[5]https://www.usda.gov/media/press-releases, 24th July 2018, discussed further in the Data section.

aluminium. Turkey responded on the 14th August by announcing new tariffs on imports of cars, alcohol and tobacco from the US.

2.2.3 Unfair trade practices for technology, intellectual property

On 18th August 2017, the US Trade Representative (USTR) initiated an investigation into whether any of China's laws, policies, practices, or actions may be unreasonable or discriminatory and may be harming American intellectual property rights, innovation, or technology development (Section 301 of the Trade Act of 1974). The results were released on 22nd March 2018 finding evidence of unfair trade practices with respect to intellectual property, technology transfer, and innovation. President Trump followed up by announcing a forthcoming response including new tariffs, new rules on investment, and a WTO dispute.

The new list of products was published on the 3rd April with a threat of up to 25 percent tariff rates on $46.2 billion of imports from China and included products such as machinery, mechanical appliances, and electrical equipment. Bown and Kolb (2019) estimate that approximately 85 percent of these imports would be intermediate inputs and capital goods with the possibility of increasing costs for American firms. In response, one day later, China published its own list of products for retaliatory tariffs covering $50 billion of US exports in products such as vehicles, aircraft, vessels and soybeans. Again escalating the confrontation, the US started to consider tariffs on an additional $100 billion of imports from China on the 5th April.

A revised list of products was released by the USTR on the 15th June, splitting the implementation into two phases, the first starting on the 6th July and covering $34 billion in imports from China (the second phase was to cover $16 billion in imports). The new list included even more intermediate inputs and capital equipment, this time totalling 95 percent of targeted products by 2017 import value. On the same day, China also released its revised retaliatory list, also including a two-phase approach, and covering vehicles as well as agricultural and food products. New products on the list included mineral fuels, medical equipment and some consumption goods whilst aircraft were removed.

Three days later, in response to China's retaliatory tariff list, President Trump directed the USTR to identify an additional $200 billion of imports from China to potentially face a rate of 10 percent, along with threatening yet another $200 billion if China was to retaliate again.

As planned, the 6th July saw the implementation of the first phase of the tariff lists defined on the 15th June, representing $34 billion for both Chinese and US tariffs. This was followed four days later by the USTR releasing the list of $200 billion of imports from China to be subject to a 10 percent tariff after public hearings in August. Approximately half of the products on this list were intermediate goods with a larger proportion of consumer goods relative to the previous lists. On the 20th July, President Trump indicated he would be willing to go even further and introduce tariffs on the remaining $262 billion of imports from China, therefore including all $504 billion of 2017 imports. On top on this, he instructed the USTR to consider 25 percent tariffs on the July 10th list of $200 billion, rather than the initial proposal of 10 percent. In response, China warned of another $60 billion of US exports that could be covered by new tariffs, ranging from 5-25 percent.

The USTR released an updated list on the 7th August for the second phase of the $50 billion list announced on the 15th June. Only 5 out of the 284 products initially identified were removed, and the tariff rate was increased from 10 percent to 25 percent on the remaining $16 billion. China also revised its second phase list the following day, covering a similar value of US exports, and removing crude oil and introducing a few other products. Both lists were then implemented on the 23rd of August as planned.

The 17th September saw the finalization of the $200 billion list of imports from China that would face a 10 percent tariff from the 24th September onwards. President Trump also added that this rate would increase to 25 percent on the 1st January 2019. In the end, 50 percent of this list were intermediate goods and 24 percent were consumer goods. Several products were dropped from the earlier list, including bedsheets, gloves, and smartwatches. China responded with its own finalized list of $60 billion of US exports, with tariffs ranging from 5-10 percent, down from the originally presented 5-25 percent. Both sets of tariffs then went into action on the 24th September.

Finally on the 1st December 2018, the US and China agreed to halt the next increase in tariffs that was due in January while they negotiate a solution. At the end of 2018, the US faced retaliation on 8 percent of its total exports whilst covering approximately 12 percent of its total imports with tariffs, largely on intermediate inputs and capital goods.

2.3 Data

2.3.1 Online job adverts

This paper uses data collected by Burning Glass Technologies (BGT), a company that scrapes what they identify to be the quasi-universe of US online job postings on a daily basis. These postings are sourced from approximately 40,000 online job boards and company websites, with a total of over 50 million US job adverts over the period 2017-2018. Hershbein and Kahn (2018) provide a more detailed overview of the dataset.

BGT classify the job adverts along a range of dimensions; this paper makes use of the classification by county and SOC (Standard Occupational Classification) codes. They also clean the data and remove duplicate postings.[6] The postings cover 3,228 counties across the US, with 98.6% of total job postings being classified by county.

Over the period considered in the analysis, January 2017 to December 2018, a total of 50,818,695 postings are included in the dataset. Figure 2.1 displays the upward trend in the time series of US monthly job postings over the period of the analysis. The raw postings are aggregated up to the month-commuting zone (CZ) level as discussed in Section 2.3.2.

2.3.2 Local labour markets

The empirical approach used in this paper builds on the literature on local labour markets (e.g. Autor et al. (2013)). Although both the BGT and regional employment data (see Section 2.3.3) required for the analysis are provided at the administrative county level, county boundaries are not generally considered adequate confines for the local economy or labour markets. In response to this, 'commuting

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

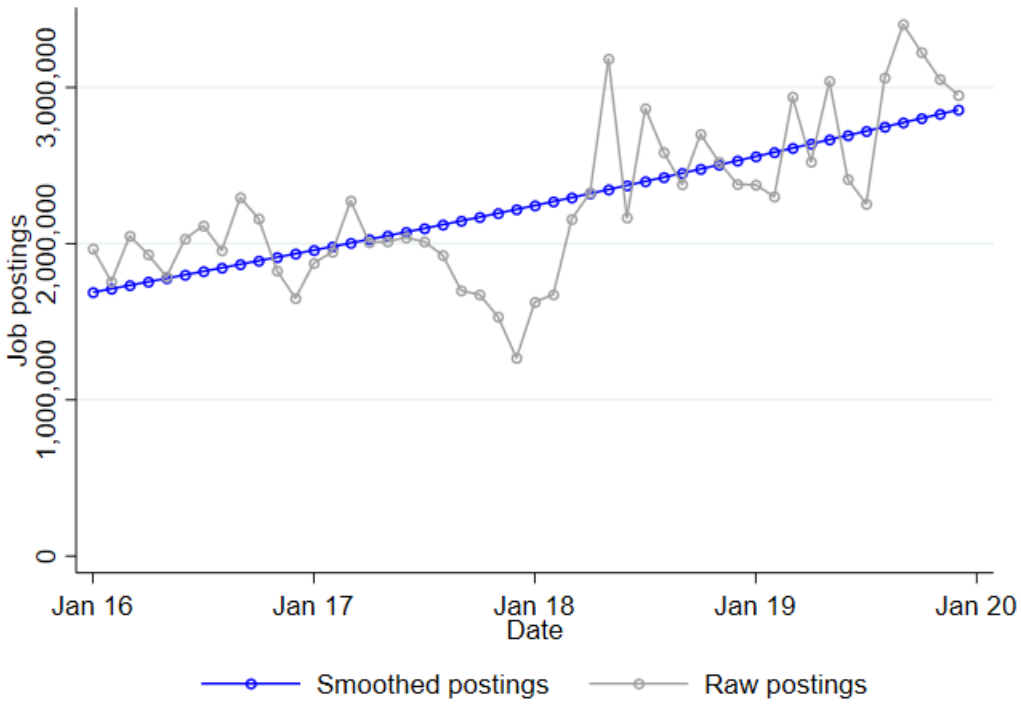


Figure 2.1: Total monthly online job postings, US

Notes: This figure displays both the unsmoothed raw monthly total postings, and a trend line which is smoothed using the Hodrick-Prescott time-series filter, removing cyclical components.

zones' were developed (originally in 1980) with the intention of providing a spatial measure of the local labour market with boundaries that are only rarely crossed by commuters.

In order to convert between counties and commuting zones, I use a crosswalk provided by the Penn State Commuting Zones/Labour Markets Data Repository.[7] This crosswalk uses the commuting zone methodology devised by the Economist Research Service (ERS) at the US Department of Agriculture, updated to 2010 zones and modified to correct for some discrepancies by Fowler et al. (2016).[8]

2.3.3 Local labour market exposure

The paper calculates local labour market exposure based on the pre-trade war sectoral employment composition of commuting zones. The employment data is originally produced by the US Census Bureau in the form of the County Business Pattern (CBP) database, and consists of employment per county and sector at the North American Industry Classification (NAICS) 6-digit level, representing the most detailed view of the United States' industrial structure available to the public. The CBP data is extracted from the US Census Bureau's Business Register, consisting of administrative tax records of all private US non-farm employer establishments, supplemented by additional information from sources such as the Economic Censuses, Annual Surveys, Current Business Surveys, and Company Organization Surveys, as well as the Bureau of Labor Statistics and the Social Security Administration. I use the modified version of the CBP produced by Eckert et al. (2020), which aims to address the fact that employment is suppressed for the majority of county-industry cells in order to protect confidentiality.[9] The authors use 'a linear programming method that exploits the large set of adding-up constraints implicit in the hierarchical arrangement of the data to impute missing employment'.

I then aggregate the county-level variables up to the commuting zone level using the crosswalk discussed in Section 2.3.2. This leads to 625 commuting zones,

[7] https://sites.psu.edu/psucz/data/

[8] The term 'labor-shed' is used in this data repository as analogous to commuting zones. Fowler et al. (2016) establish a set of metrics for comparing different labour market delineations and provide an overview of these differences.

[9] http://www.fpeckert.me/cbp/

with total postings over the period ranging from 98 to 277,0274 per commuting zone, and total employment (excluding farm employment) ranging from 279 to 6,830,871.

In order to analyse the relationship between job postings and tariff exposure at the local labour market level, I weight national sectoral exposure measures using baseline employment shares within a local labour market for each industry. The regional (commuting zone) tariff exposure measure is defined as:

$$\text{tariff measure}_{r,t} = \sum_{j} \text{empl share}_{rj,2015} \times \text{tariff exposure}_{j,t} \tag{2.1}$$

where $\text{empl share}_{rj,2015}$ is industry j share of CZ r employment in 2015, and $\text{tariff exposure}_{j,t}$ is the dollars per worker exposure of industry j in month t to the varying tariff measures (output, input and export) discussed in the following sections. Pre-sample employment shares (2015) are used for exogeneity.

The CBP excludes farm employment, consisting of Crop Production (3-digit NAICS 111) and Animal Production and Aquaculture (3-digit NAICS 112), but includes Support Activities for Agriculture and Forestry (3-digit NAICS 115). Following Blanchard et al., I therefore allocate farm-related tariffs to employment in the associated support activities. Specifically, I calculate the average tariff across 3-digit NAICS sector 111 and allocate this to total employment in 4-digit NAICS sector 1151. I then calculate the average tariff across 3-digit NAICS sector 112 and allocate this to total employment in 4-digit NAICS sector 1152.[10]

2.3.4 Sectoral tariff exposure

The following sections describe the construction of the sectoral tariff exposure measures used to generate local labour market exposure in equation 2.1: output exposure, input exposure, and export exposure. The three measures focus on tariff barriers specifically and do not take into account any changes in quotas, in the

[10]I do not remove sectors 111 and 112 from the BGT data for two reasons. First, the measure described in the text still accounts for the tariffs in these sectors, even if they are allocated to slightly different NAICS codes when conducting the employment weightings. Second, the coverage and accuracy of the sector classifications in the BGT data is much weaker than the county classification and hence it's unclear that I would be able to convincingly isolate and remove postings within these particular sectors. The classification issue comes from the challenge of assigning a sector to the data scraped from a job posting (i.e. job postings will almost never provide NAICS codes inside the associated text).

form of import quotas or voluntary export restraints, and hence could be seen as a lower bound estimate of the exposure to new trade barriers.

Exposure to reduced competition through import tariffs

One channel through which imposing or increasing import tariffs could affect US businesses is by increasing the price of imports that compete with US products, hence rendering US firms more competitive in the domestic market. This protectionist motivation represents one possible interpretation of the US administration's trade policy choices, consistent with the 'bring our jobs back' rhetoric. As in Blanchard et al. (2019), the sectoral exposure used in this paper creates an average dollar value of exposure to the tariff per worker in that sector, based on US imports in 2016:

$$\text{output tariff exposure}_{j,t} = \frac{\sum_{c,p \in j} \text{US imports}_{pc,2016} \times \text{US tariff}_{pc,t}}{\text{L}_{j,2015}} \tag{2.2}$$

where $\text{US tariff}_{pc,t}$ is the percentage tariff rate applied to imports of product p (HS-10) from country c in month t, $\text{US imports}_{pc,2016}$ is the value of imports of product p from country c in 2016, and $\text{L}_{j,2015}$ is the number of workers employed in sector j nationally in 2015. I use pre-trade war imports and employment to avoid capturing any changes that may occur to both of these in response to the tariffs. The measure, along with the two following measures, can be interpreted in units of \$1,000 per worker exposure.

Figure 2.2 provides a map of the output tariff exposure measure once weighted by employment composition of commuting zones as discussed in Section 2.3.3. The map shows a concentration of exposure in the East of the United States, including large sections of the Midwest, Northeast and South. There is relatively little, although nonzero, exposure in the Great Plains with pockets of highly exposed commuting zones in the West.

Exposure to increased cost of imported inputs

Alongside potential protection of US industries, tariffs may have the additional negative impact of increasing the cost of inputs to these or other US industries. If industries typically purchase imported inputs then the imposition of tariffs

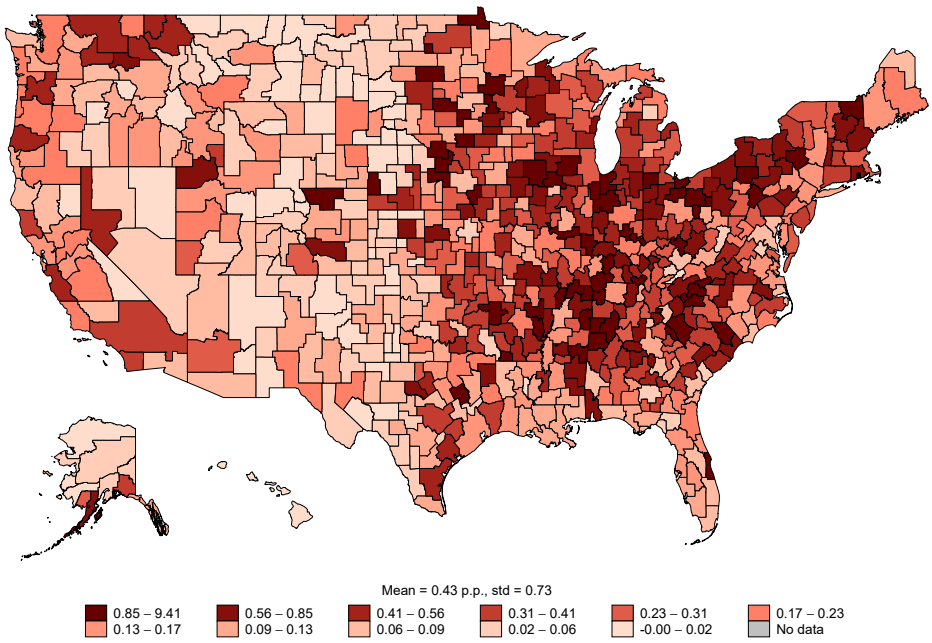


Figure 2.2: Exposure of commuting zones: output tariffs

Notes: This map displays the change in the baseline employment-weighted output tariff exposure for each commuting zone between December 2017 and December 2018. Darker colours represent more exposed areas.

on these products would increase costs either directly, or through substitution to more expensive domestic producers. Increased costs could lead to reduced production and hence reduced labour demand. I calculate this exposure by taking the output measure from above and, using US input-output tables, weighting it by the share this 'input' industry makes up in all of the 'output' industry's inputs.[11] Specifically, the measure is calculated as follows:

$$\text{input tariff exposure}_{k,t} = \frac{1}{\text{L}_{k,2015}} \sum_j S_{jk} \sum_{c,p \in j} \text{US imports}_{pc,2016} \times \text{US tariff}_{pc,t} \quad (2.3)$$

where k is the output sector, j is the input sector (6-digit BEA level), and $S_{j,k}$ is the inputs from sector j as a share of total inputs used by sector k sourced from input-output tables.

Figure 2.3 provides a map of the input tariff exposure measures once weighted by employment composition as discussed in Section 2.3.3. As for the output tariffs,

[11] Here US Bureau of Economic Analysis (BEA) input-output tables are used, as in Amiti et al. (2019), along with concordances between NAICS and BEA industry codes.

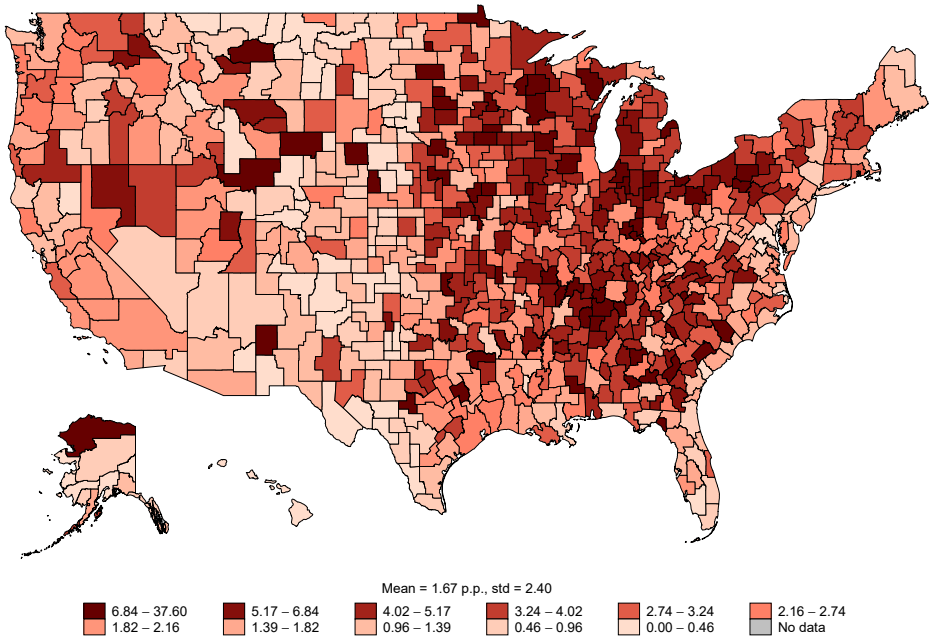


Figure 2.3: Exposure of commuting zones: input tariffs

Notes: This map displays the change in the baseline employment-weighted input tariff exposure for each commuting zone between December 2017 and December 2018. Darker colours represent more exposed areas.

the map shows a concentration in the East with lower exposure in the Great Plains and West, but with a different pattern of variation within these regions.

Exposure to retaliatory tariffs

In response to the imposition of US tariffs, a number of countries implemented retaliatory tariffs on US exports to their countries (see Table 2.1 for an overview). A sectoral exposure measure can be constructed as for output tariffs, but using foreign tariffs and US exports instead of imports:

$$\text{export tariff exposure}_{j,t} = \frac{\sum_{c,p \in j} \text{US exports}_{pc,2016} \times \text{Foreign tariff}_{pc,t}}{\text{L}_{j,2015}} \tag{2.4}$$

where $\text{US exports}_{pc,2016}$ is the value of US exports of product p (HS-6) to destination country c in 2016, and $\text{Foreign tariff}_{pc,t}$ is the tariff levied by country c on its imports of product p from the US in month t.

Figure 2.4 provides a map of the export tariff exposure measures once weighted by employment composition as discussed in Section 2.3.3. Relative to the other two

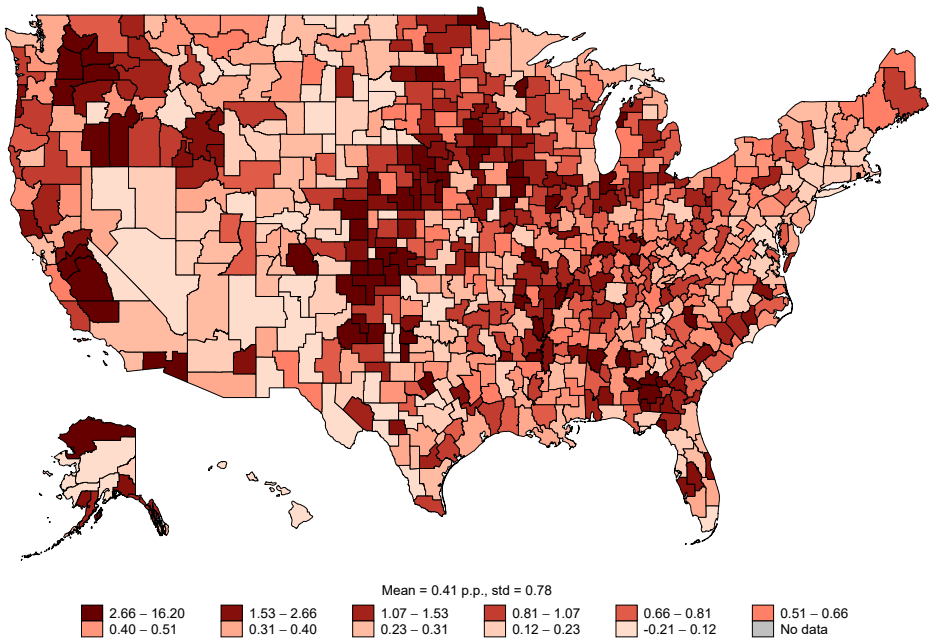


Figure 2.4: Exposure of commuting zones: export tariffs

Notes: This map displays the change in the baseline employment-weighted export tariff exposure for each commuting zone between December 2017 and December 2018. Darker colours represent more exposed areas.

exposure measures, export tariff exposure shows a much greater concentration in the Great Plains and West, likely reflecting the concentration of agricultural products included in the retaliatory tariffs.

2.3.5 Classifying job adverts by occupation and skill

The BGT job postings data provide information on the US Standard Occupational Classification (SOC) of each of the postings (96% coverage). Examples at the 2-digit level include 'Business and Financial Operations' or 'Food Preparation and Serving Related'; the full range is presented in Table 2.6 in the Appendix.

In order to investigate the impact of the tariffs on job postings by skill level, it is necessary to allocate postings into skill categories. Included in the BGT data is a variable for the minimum education level required in the job advert. Ideally the postings could be split by this variable, however, the coverage is relatively low: only approximately 51 percent of postings have positive assigned minimum

values of education.[12] In order to include the widest possible range of postings in the skill classification, I then use the available minimum education data to classify occupations by skill level. This allows me to map skill level to postings through the high coverage of occupation classifications.

The definition of 'high skill' that I use is that the average required education (when data for positive minimum education is available) for the occupation across the whole dataset is greater than or equal to 14 years; the equivalent of an associate's degree in the US. All of the analysis in the main body of the paper uses the categorisation based on 2-digit SOC codes (as presented in Table 2.6), but the analysis is repeated in the Appendix for 6-digit SOC codes.

Figure 2.5 displays the evolution of high skill and low skill job postings over time. Although both are increasing over time, a gap can been seen between the progression of the two types with high skill postings increasing more slowly than low skill postings over the period.

2.3.6 Agricultural subsidies

As discussed in Section 3.2, significant proportions of the retaliatory tariffs were directed toward US agriculture exports. In response, on the 24th July 2018 the US administration announced plans to provide subsidies to American farmers of up to $12 billion under the 2018 Market Facilitation Program (MFP). The explicit justification for these subsidies was 'to assist farmers in response to trade damage from unjustified retaliation' and involved the application of a 1933 law devised to support farmers hit by the Great Depression. Products specifically mentioned for the subsidy include soybeans, sorghum, wheat, dairy, and hogs.

Blanchard et al. (2019) calculate estimates of county-specific total subsidy values combining the announced subsidy rates for key commodities with preceding years production or inventory values.[13] I use their values and aggregate them up

[12] This could be due to challenges in scraping this type of information from online adverts, or because many adverts do not explicitly name a minimum education level.

[13] See the appendix in Blanchard et al. (2019) for more details on the full set of commodities included and the data sources.

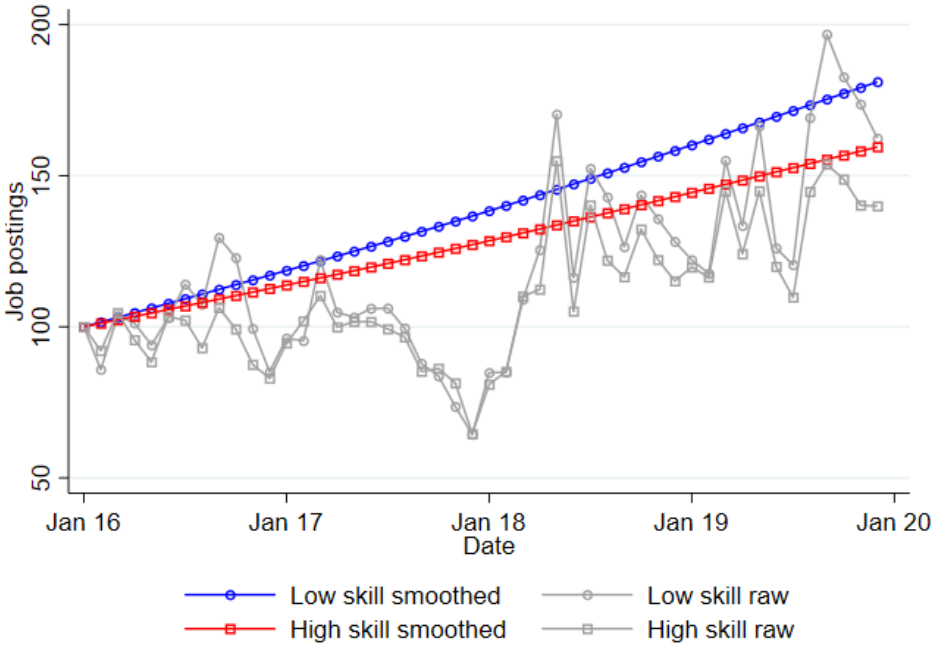


Figure 2.5: High and low skill job postings over time

Notes: This figure displays both the unsmoothed raw monthly total postings, and a trend line which is smoothed using the Hodrick-Prescott time-series filter, removing cyclical components, for high skill and low skill postings. Here high skill is defined by greater than or equal to an average of 14 years of education for the associated 2-digit SOC occupation.

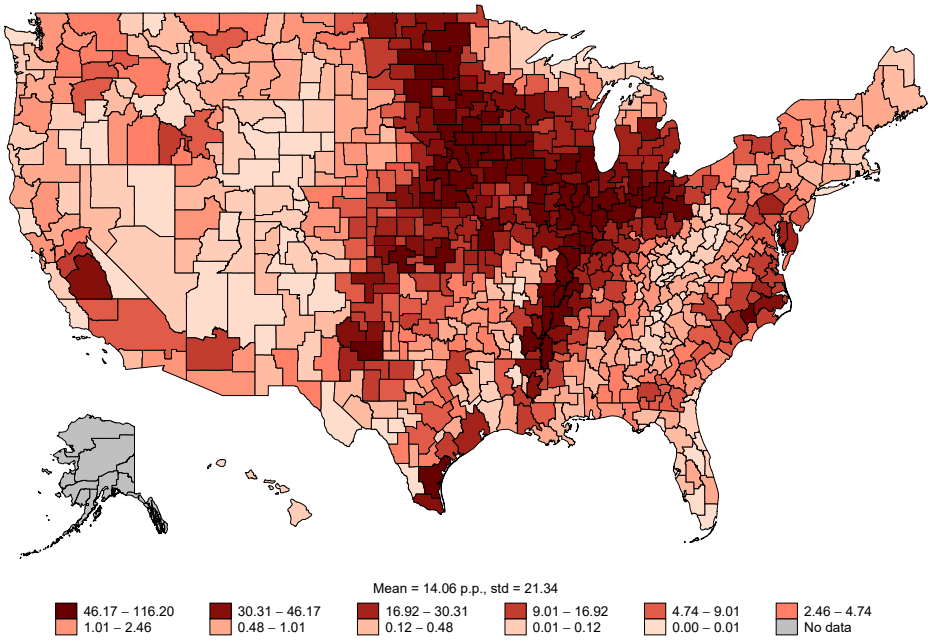


Figure 2.6: Map of MFP agricultural subsidies

Notes: This map displays the total estimated agricultural subsidies, under the Market Facilitation Program of 2018, for each commuting zone in the US. Darker colours represent more exposed areas.

to the commuting zone level using the crosswalk discussed in Section 2.3.2.[14]

As can be seen in Figure 2.6, the main recipients of agricultural subsidies were located in the Midwest and to a degree the Great Plains, with very little in the East and West.

Table 3.1 displays summary statistics for monthly job postings and all other key variables used in the paper.

2.4 Empirical strategy

2.4.1 Baseline specification

The baseline specification estimates the impact of tariffs, as a function of commuting zone exposure to these tariffs through industrial employment composition, on monthly online job postings from January 2017 to December 2018. I estimate the

[14]These measures are in total dollars (units of $1,000,000) per commuting zone rather than being expressed in per worker terms. The reason for this is that the CBP excludes farm employment and hence the resulting measure would be agricultural subsidies per non-farm worker which does not capture the desired effect. The average size of the agricultural sector is also controlled for, in principle, by the CZ fixed effects.

TABLE 2.2. SUMMARY STATISTICS

Variables	Mean	Median	Min.	Max.	Std Dev.
Job postings:					
Monthly postings	656	71	0	103,542	3,022
Monthly postings low skill (educ.)	300	40	0	48,651	1,268
Monthly postings high skill (educ.)	357	29	0	55,248	1,800
Monthly postings low skill (degree)	228	33	0	37,458	965
Monthly postings high skill (degree)	428	37	0	66,084	2,096
Exposure Measures:					
Output tariff exposure	0.43	0.21	0	9.41	0.73
Input tariff exposure	1.67	0.84	0	37.6	2.40
Export tariff exposure	0.41	0.24	0	16.2	0.78
Other:					
Agricultural subsidies	16	3.72	0	143	25.1

Notes: This table displays summary statistics for all of the key variables used in the analysis. The dataset includes a total of 625 commuting zones, across 24 months (Jan 2017 - Dec 2018), totalling 15,000 observations. Summary statistics are taken across all CZ-time observations. Agricultural subsidy data is only available for 610 CZs. All tariff exposure measures can be interpreted in units of $1,000 per worker average exposure, and agricultural subsidies in units of $1,000,000.

following model:

$$\log(\text{postings}_{rt}) = \beta_0 + \beta_1 \text{export tariff exposure}_{rt} +$$
$$\beta_2 \text{output tariff exposure}_{rt} + \beta_3 \text{input tariff exposure}_{rt} + \gamma_t + \gamma_r + \epsilon_{rt} \quad (2.5)$$

where postings_{rt} are the total number of online job adverts posted in month-year t and commuting zone r, output tariff exposure_{rt} is a measure of the exposure of CZ r to protection through US import tariffs, input tariff exposure_{rt} is a measure of CZ exposure to US tariffs on imported inputs, and export tariff exposure_{rt} is a measure of CZ exposure to retaliatory tariffs on US exports. The varying measures of exposure are discussed in more detail in Section 2.3. The specification controls for time-invariant CZ-specific factors with the inclusion of CZ fixed effects, γ_r, and common time trends are controlled for with year-month fixed effects, γ_t.

I am also interested in the impact of trade policy for different skill groups and so I run the specification in (2.5) separately for each category of job postings, with these categories defined in Section 2.3.

The tariff rates included in my tariff exposure measures are the rates that applied to trade in month-year t. In an ideal experiment, the tariff changes would be completely unexpected for the measured effects to approach a causal interpretation, however, in several cases lists of targeted products were published by both the US and trade partners in advance of implementation. Despite this, I argue that the nature of the negotiations meant that firms faced very large uncertainty about the likelihood of tariffs up until the moment that these tariffs were actually implemented, as discussed in Section 3.2. First, products were routinely both added and taken away from these tariff lists in the gap between announcement and implementation. Second, the implementation of the tariffs was delayed in several occurrences and exemptions were carved out at the last minute for specific country-products. Third, firms would not have realistically expected such a large and rapid increase in tariff barriers given how long it had been since this type of unilateral tariff action had been adopted by a major advanced country. To the extent that firms did act to anticipate tariff changes, their response would typically have moved in the same direction as their response to the actual tariff changes,

hence working against finding a significant effect in the month of implementation and implying that my estimates represent lower bounds.

2.5 Results

2.5.1 Baseline results

The baseline results are presented in Table 3.2. The specifications in columns (1), (2) and (3) include each of the output, input and export tariff exposure measures in turn, with the remaining columns displaying combinations of these measures. The estimated effect of the output tariff measure is negative across all specifications, but becomes insignificant as soon as the imported input tariff exposure is included. The simple correlation between these measures is 0.48, and it appears that the dominant effect is that of the imported input tariff exposure. The negative sign, along with the lack of significance, flies in the face of the potential protectionist motive of the import tariffs which would predict a positive coefficient for the output exposure measure (due to domestic industries becoming more price competitive relative to foreign competitors).

The estimated effect of imported input tariff exposure is significant and negative across the board. This is in line with expectations, as more costly imported inputs represent a negative shock for firms, consistent with a reduction in hiring. The magnitude is fairly consistent across specifications; taking column (7) as the preferred specification, a one standard deviation increase in exposure ($2,400 per worker) led to a 3.6 percent decrease in job postings.

The estimated effect of export tariff exposure is also consistently negative and significant across specifications, showing that retaliatory tariffs had a negative impact on US labour demand. Here a one standard deviation increase in exposure ($780 per worker) led to a reduction of 7.3 percent in job postings.

The baseline results for these three tariff exposure measures point to an overall negative effect of the trade war on labour demand in the US during 2018. These are, however, short term effects and it is possible that over time as longer term tariff rates become clearer the effects could be stronger or weaker. For example, if individuals in the US believe they will receive longer term protection from foreign competition they may begin to establish new firms to produce products which

TABLE 2.3. BASELINE RESULTS

Dep. var. ln(postings+1)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Output tariff exposure	-0.048***			-0.020		-0.039***	-0.016
	(0.014)			(0.013)		(0.013)	(0.014)
Imported input tariff exposure		-0.019***		-0.017***	-0.016**		-0.015**
		(0.006)		(0.006)	(0.006)		(0.006)
Export tariff exposure			-0.112***		-0.096***	-0.105***	-0.094***
			(0.029)		(0.032)	(0.028)	(0.032)
Observations	15,000	15,000	15,000	15,000	15,000	15,000	15,000
Adjusted R-squared	0.976	0.976	0.976	0.976	0.976	0.976	0.976
FE	CZ YM	CZ YM	CZ YM	CZ YM	CZ YM	CZ YM	CZ YM
Cluster	CZ YM	CZ YM	CZ YM	CZ YM	CZ YM	CZ YM	CZ YM

Notes: This table displays the results from the regressions of the log of monthly job postings in each commuting zone on the associated trade barrier exposure measures. All specifications include CZ and month-year (YM) fixed effects, and standard errors (in parentheses) are two-way clustered at the CZ and month-year level. Tariff exposure measures should be interpreted in units of $1,000 dollars per worker. *** p<0.01, ** p<0.05, * p<0.1.

would otherwise have been produced almost entirely abroad, and hence increase hiring. Similarly, if it becomes clear that the long term tariff rates are actually lower than those implemented during the trade war then there may be some reversal of the short term negative effects. It is also unclear to what extent the observed effects are due to uncertainty around future costs, as opposed to the direct costs themselves. As discussed in Section 3.2, there was a significant lack of clarity regarding the likely scope and intensity of the trade war throughout 2018.

2.5.2 Agriculture subsidies

Table 2.4 presents the baseline results with additional controls for both the value of agricultural subsidies in a CZ, as defined in Section 2.3.6, and the interaction of these subsidies with the export tariff exposure. Both of these variables are interacted with a dummy taking the value 1 from August 2018 onwards, as the subsidies were announced in July 2018.

The main results are robust to the inclusion of both the subsidies term and its interaction with the export tariff exposure.[15] The coefficient of the imported input tariff exposure does not change at all, while the export tariff exposure coefficient is marginally reduced in magnitude. There is some weak evidence that the subsidy

[15] All specifications use the slightly reduced dataset with non-missing subsidy values which covers 615 instead of 625 CZs

directly had a positive impact on job postings when included alongside the interaction term in column (3), but this effect does not appear to be any stronger for commuting zones that were more exposed to retaliatory tariffs as was the declared intention of the US Administration.[16] Here a one standard deviation increase in subsidies ($25,100,000), led to a 2.5 percent increase in postings.

The weakness of the subsidy results may be due to several factors. The first is that the effect is small and difficult to identify, especially given the few months included in the sample after the announcement of the subsidies. The second is that the online job adverts data may insufficiently capture farm labour, and particularly informal farm labour. Third, due to the construction of the export tariff exposure measure using CBP data, which excludes farm labour, the results may insufficiently capture the part of retaliatory tariff exposure which affected farm labour. Hence, the agricultural subsidies would be less effective at pushing back against this negative impact in this specification.

2.5.3 Impact on different skill groups

Table 2.5 displays the baseline regressions run separately for high skill and low skill job adverts. The classification here categorises 2-digit SOC codes into skill levels based on whether the average number of years of education required is greater than or equal to 14 (discussed further in Section 2.3). Panel A shows the results for low skill job adverts, while Panel B shows the results for high skill job adverts.

Relative to the aggregate baseline coefficients, presented for reference in column (6), the low skill results remain significant and increase slightly in magnitude for both imported input and export tariff exposure measures. The opposite is seen for high skill results, with coefficients that are smaller in magnitude than the aggregate results. It therefore appears that it is low skill workers that are disproportionately affected by both the imported input tariffs and the export tariffs.

The agricultural subsidies only have a positive and significant impact for high skill workers (see column (5)), perhaps contrary to expectations. This may be

[16] If anything, the coefficient on the interaction term is negative although it has a p-value of 0.135. If the coefficient were significant, it would lead to a negative overall effect for export tariff exposures of over 2.69, is the case in only 164 CZ-year-month observations spread across 21 out of 615 commuting zones.

TABLE 2.4. REGRESSION RESULTS INCLUDING AGRICULTURAL SUBSIDIES

Dep. var. ln(postings+1)	(1)	(2)	(3)
Output tariff exposure	-0.005	-0.009	-0.006
	(0.015)	(0.014)	(0.015)
Imported input tariff exposure	-0.020***	-0.020***	-0.020***
	(0.007)	(0.007)	(0.007)
Export tariff exposure	-0.126***	-0.131***	-0.120***
	(0.035)	(0.036)	(0.036)
Total ag subsidy		0.001	0.001*
		(0.001)	(0.001)
Ag subsidy * Export tariff exposure			-0.000
			(0.000)
Observations	14,640	14,640	14,640
Adjusted R-squared	0.977	0.977	0.977
FE	CZ YM	CZ YM	CZ YM
Cluster	CZ YM	CZ YM	CZ YM

Notes: This table displays the results from the regressions of the log of monthly job postings in each commuting zone on the associated trade barrier exposure measures, with the addition of controls for agricultural subsidies. Only observations with non-missing values of agricultural subsidies are included, hence the small differences between column (1) and the baseline results. All specifications include CZ and month-year (YM) fixed effects, and standard errors (in parentheses) are two-way clustered at the CZ and month-year level. Tariff exposure measures should be interpreted in units of $1,000 dollars per worker and agricultural subsidies in units of $1,000,000. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

TABLE 2.5. IMPACT BY SKILL GROUP

Dep. var. ln(postings+1)	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Low skill					Baseline
Output tariff exposure	-0.052***			-0.006	-0.007	-0.006
	(0.016)			(0.016)	(0.016)	(0.015)
Imported input tariff exposure		-0.024***		-0.022***	-0.022***	-0.020***
		(0.007)		(0.007)	(0.007)	(0.007)
Export tariff exposure			-0.152***	-0.140***	-0.133**	-0.120***
			(0.046)	(0.046)	(0.049)	(0.036)
Total ag subsidy					0.001	0.001*
					(0.001)	(0.001)
Ag subsidy * Export tariff exposure					-0.000	-0.000
					(0.000)	(0.000)
Adjusted R-squared	0.964	0.964	0.964	0.964	0.964	0.977
	Panel B: High skill					Baseline
Output tariff exposure	-0.038**			-0.008	-0.010	-0.006
	(0.016)			(0.017)	(0.016)	(0.015)
Imported input tariff exposure		-0.016**		-0.014**	-0.015**	-0.020***
		(0.006)		(0.006)	(0.006)	(0.007)
Export tariff exposure			-0.110***	-0.102***	-0.099***	-0.120***
			(0.033)	(0.032)	(0.034)	(0.036)
Total ag subsidy					0.001**	0.001*
					(0.001)	(0.001)
Ag subsidy * Export tariff exposure					-0.000	-0.000
					(0.000)	(0.000)
Adjusted R-squared	0.964	0.964	0.964	0.964	0.964	0.977
Observations	14,640	14,640	14,640	14,640	14,640	14,640
FE	CZ YM	CZ YM	CZ YM	CZ YM	CZ YM	CZ YM
Cluster	CZ YM	CZ YM	CZ YM	CZ YM	CZ YM	CZ YM

Notes: This table displays the results from the regressions of the log of monthly job postings in each commuting zone on the associated trade barrier exposure measures, with the addition of controls for agricultural subsidies. The postings variables are broken down into high and low skill postings using the average education level (threshold of 14 years of education) of their associated 2-digit SOC occupations. All specifications include CZ and month-year (YM) fixed effects, and standard errors (in parentheses) are two-way clustered at the CZ and month-year level. Tariff exposure measures should be interpreted in units of $1,000 dollars per worker and agricultural subsidies in units of $1,000,000. *** p<0.01, ** p<0.05, * p<0.1.

because the online job postings data captures high skill agricultural jobs more effectively than the more informal low skill agricultural jobs that are less likely to be published online.

2.5.4 Aggregate counterfactual effects

In order to evaluate the plausible effects of these results for the full sample, I carry out a basic counterfactual exercise on the baseline results. For each commuting zone, I consider what the predicted values for monthly postings would have been

if the tariff rates had stayed the same as January 2017 throughout the period of analysis. This approach follows closely that used in Chapter 1 of this thesis.

Specifically, I take the fitted values of the specification in column (7) of Table 3.2 and then subtract the difference in exposure between any given month and that at the start of the period (January 2017), multiplied by the relevant estimated coefficient. Using the exponential function I return the fitted value and the estimated counterfactual to a count measure of postings and then calculate the estimated difference in postings for each month and each CZ.

First focusing only on the counterfactual of zero changes to tariffs on imported inputs, I estimate a total of 121,571 fewer postings occurred over the period than would have been the case in this counterfactual world. Figure 2.7 shows how these were spread out over time, with month 1 being January 2017. All of the changes are concentrated in the period after February 2018, getting more severe month by month.

A similar calculation can be made for export tariff exposure leading to an estimated total of 53,544 fewer postings, again concentrated in 2018 as shown in Figure 2.7. Adding these two components together we see a counterfactual impact of 175,115 job postings fewer as a result of the increases in both import and retaliatory tariffs during 2018 (also displayed in Figure 2.7). This represents 0.6 percent of the aggregate postings for 2018 (28,555,238) and 0.9 percent for the second half of the year, with no sign of reducing into 2019.

2.6 Robustness checks

2.6.1 Pre-trade war placebo

The baseline specification controls for time-invariant CZ-specific factors with the inclusion of CZ fixed effects, and common time trends are controlled for with year-month fixed effects. However, one may still be concerned by CZ-time varying factors that affect job postings and are correlated with the exposure variables. More broadly, there may be global sectoral trends which happen to correlate with exposure to US and retaliatory tariffs. I attempt to address this concern by running a placebo test on the pre-trade war period. To do this, I lag the 2018 tariff exposures by one year and see whether job postings respond to these changes in 2017 when

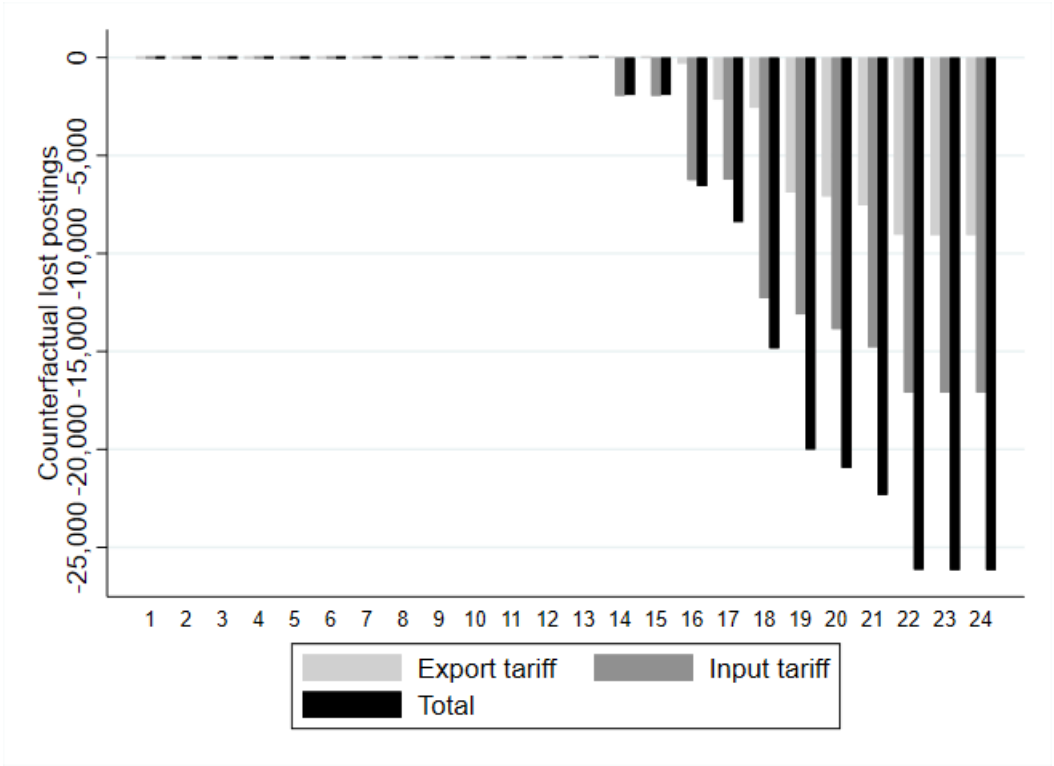


Figure 2.7: Counterfactual change in job postings

Notes: Counterfactual postings calculated using the difference in predicted postings when tariff values are set to those of January 2017, before the 2018 tariff hikes. Output tariffs not shown as the baseline results are not significant. Counterfactual predicted values are based on the specification presented in column (7) of Table 3.2

there were in fact no tariff changes. If the baseline results capture medium-term trends that are not related to tariff exposure then we would expect to see similar results in this placebo test. Insignificant results would support the claim that it is in fact the tariff changes that matter.[17]

Table 2.8 in the Appendix presents the results of this placebo test. The resulting coefficients are not significant across all specifications, suggesting that this impact was not observed prior to the start of the trade war.

2.6.2 Alternative tariff exposure measures

The particular form of the exposure measures used in this paper follows examples such as Blanchard et al. (2019) and Autor et al. (2013), but there are a range of ways in which tariff exposure can be calculated. I additionally consider five other formulations to check robustness, and the results are presented in Table 2.9 in the Appendix along with full definitions of the measures. Column (1) repeats the main measure used in the paper, while column (2) adjusts this measure applying the weighting to $ln(1 + \text{tariff rate}_{pc,t})$ rather than directly to the US or retaliatory tariff rates. Column (3) takes a similar approach but applies the log transformation to the measure after the trade and employment weighting is already applied.

Columns (4)-(6) weight by sectoral output rather than employment. For example, the sectoral output tariff exposure (later weighted by CZ employment shares) for the specification in column (4) is constructed as follows:

$$\text{output tariff exposure}^{(2)}_{j,t} = \frac{\sum_{c,p \in j} \text{US imports}_{cp,2016} \times \ln(1+\text{import tariff}_{cpt})}{\text{US imports}_{j,2016}} \quad (2.6)$$

where c is the county of origin, and p is the 10-digit HS product. Column (5) is similar but additionally multiplies by the sectoral share of imports in output, where output is defined as domestic shipments plus imports minus exports as in Amiti et al. (2019). Finally, column (6) instead applies the log transformation after the import weighting and then multiplies again by the import share.

[17] It may be worth nothing that an alternative interpretation of this placebo test is that tariff changes were not anticipated 12 months in advance of their implementation.

The results suggest that these different formulations of the exposure measure do not significantly change the conclusions from the baseline. The estimated effects of both the imported input and export tariff exposure are negative and highly significant in all specifications. There is some evidence of positive and significant coefficients for the output tariff exposure, but only in two out of the six cases.[18]

The estimated effects of the agricultural subsidies remain positive and significant across the board with the interactions remaining insignificant in all but one specification. Taken together these results provide confidence in the main conclusions that firms did appear to be adjusting hiring significantly in response to tariff changes but only when exposed through exports or imported inputs.

2.7 Conclusion

This paper uses data on the near universe of US online job postings from January 2017 to December 2018 to analyse how the 2018 tariff increases by both the US and its trading partners affected US labour demand. I calculate three measures of tariff exposure to account for: first, the protection of US industries by tariffs on their output products; second, the increased cost for US producers due to tariffs on their imported inputs; and third, foreign tariffs on US exports in retaliation to the US import tariff increases.

I find that both imported input tariffs and retaliatory tariffs on US exports had a significant negative impact on job postings. For imported input tariffs, a one standard deviation increase in exposure led to a 3.6 percent decrease in hiring, and for export tariffs, a one standard deviation increase in exposure led to a reduction of 7.3 percent. These effects appear to be stronger for low skill postings than for high skill postings. There is no evidence that the protectionist channel increased postings for sectors that faced reduced competition from foreign imports due to the tariffs. A back-of-the-envelope counterfactual calculation estimates the loss in postings at 175,115, 0.6 percent of 2018 postings, with similar sized effects continuing into 2019.

[18]It is possible that the positive results for the output tariff measure are an indication that these particular formulations more accurately capture tariff exposure but it is not clear a priori why this would be the case.

I also investigate the impact of the agricultural subsidies awarded under the Market Facilitation Program in 2018. There appears to be some evidence for a positive effect of the subsidies on postings but, contrary to the stated objectives, no evidence that this effect was stronger for commuting zones that were more exposed to the negative effects of the retaliatory tariffs.

The results are robust to a placebo test which asks whether 2017 postings reacted to 2018 tariff changes, as well as when using alternative constructions of tariff exposure.

Overall these results paint a negative picture of the 2018 tariffs with respect to one of their key stated goals: bringing jobs back to the US. The results are of course only short term, and the final impact on labour demand will depend on the longer term applied tariffs rates and the degree of uncertainty around future unilateral usage of tariffs to solve bilateral disputes. This paper adds to a fast expanding literature providing evidence of the negative short-run impacts of unilateral tariff hikes and the responses that ensue from trade partners. It remains to be seen what future role will be played by the WTO in bringing the system back into a rules-based framework.

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Appendix of Chapter 2

TABLE 2.6. POSTING OCCUPATIONS AND SKILL LEVELS

Occ. #	Occupation name	Postings per occ.	Ave. years educ.	Frac. with $\geq$ degree
11	Management	7,635,603	15.5 (H)	0.84
13	Business and Financial Operations	4,590,688	15.5 (H)	0.87
15	Computer and Mathematical	6,519,437	15.7 (H)	0.94
17	Architecture and Engineering	2,095,270	15.3 (H)	0.83
19	Life, Physical, and Social Science	719,991	16.5 (H)	0.88
21	Community and Social Service	852,672	15.8 (H)	0.81
23	Legal	261,428	17.5 (H)	0.83
25	Education, Training, and Library	1,674,570	15.8 (H)	0.80
27	Arts, Design, Entertainment, Sports, and Media	1,228,772	14.4 (H)	0.61
29	Healthcare Practitioners and Technical	7,736,250	15.1 (H)	0.86
31	Healthcare Support	1,086,065	12.1 (L)	0.06
33	Protective Service	816,851	12.6 (L)	0.14
35	Food Preparation and Serving Related	1,068,079	12.4 (L)	0.11
37	Building and Grounds Cleaning and Maintenance	509,504	12.1 (L)	0.04
39	Personal Care and Service	541,215	12.7 (L)	0.19
41	Sales and Related	5,718,844	13.6 (L)	0.41
43	Office and Administrative Support	5,886,668	13.0 (L)	0.29
45	Farming, Fishing, and Forestry	26,328	13.2 (L)	0.34
47	Construction and Extraction	336,449	12.4 (L)	0.12
49	Installation, Maintenance, and Repair	1,521,031	12.3 (L)	0.12
51	Production	1,290,258	12.6 (L)	0.16
53	Transportation and Material Moving	1,359,333	12.2 (L)	0.05
55	Military Specific	63,610	12.8 (L)	0.18
-	Not specified	2,320,844	14.3	0.58

Notes: Occupations labeled as high skill are indicated by '(H)' and low skill occupations are indicated by '(L)'. *Source*: US Standard Occupational Classification.

TABLE 2.7. IMPACT BY SKILL GROUP - 6-DIGIT SOC LEVEL

Dep. var. ln(postings+1)	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Low skill					Baseline
Output tariff exposure	-0.057***			-0.010	-0.010	-0.006
	(0.016)			(0.017)	(0.017)	(0.015)
Imported input tariff exposure		-0.025***		-0.023***	-0.023***	-0.020***
		(0.007)		(0.008)	(0.008)	(0.007)
Export tariff exposure			-0.158***	-0.145***	-0.141***	-0.120***
			(0.046)	(0.046)	(0.049)	(0.036)
Total ag subsidy					0.001	0.001*
					(0.001)	(0.001)
Ag subsidy * Export tariff exposure					-0.000	-0.000
					(0.000)	(0.000)
Adjusted R-squared	0.966	0.966	0.966	0.966	0.966	0.977
	Panel B: High skill					Baseline
Output tariff exposure	-0.034**			-0.005	-0.006	-0.006
	(0.015)			(0.017)	(0.016)	(0.015)
Imported input tariff exposure		-0.015**		-0.013**	-0.014**	-0.020***
		(0.006)		(0.006)	(0.006)	(0.007)
Export tariff exposure			-0.107***	-0.100***	-0.092**	-0.120***
			(0.036)	(0.035)	(0.037)	(0.036)
Total ag subsidy					0.001**	0.001*
					(0.001)	(0.001)
Ag subsidy * Export tariff exposure					-0.001	-0.000
					(0.000)	(0.000)
Adjusted R-squared	0.976	0.976	0.976	0.976	0.976	0.977
Observations	14,640	14,640	14,640	14,640	14,640	14,640
FE	CZ YM	CZ YM	CZ YM	CZ YM	CZ YM	CZ YM
Cluster	CZ YM	CZ YM	CZ YM	CZ YM	CZ YM	CZ YM

Notes: This table displays the results from the regressions of the log of monthly job postings in each commuting zone on the associated trade barrier exposure measures. The postings variables are broken down into high and low skill postings using the average education level (threshold of 14 years of education) of their associated 6-digit SOC occupations. All specifications include CZ and month-year (YM) fixed effects, and standard errors (in parentheses) are two-way clustered at the CZ and month-year level. Tariff exposure measures should be interpreted in units of $1,000 dollars per worker and agricultural subsidies in units of $1,000,000. *** p<0.01, ** p<0.05, * p<0.1.

TABLE 2.8. PRE-TRADE WAR PLACEBO FOR 2017

Dep. var. ln(postings+1)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Output tariff exposure	-0.011			-0.022		-0.009	-0.021
	(0.014)			(0.013)		(0.014)	(0.013)
Imported input tariff exposure		0.005		0.007	0.006		0.007
		(0.006)		(0.007)	(0.006)		(0.007)
Export tariff exposure			-0.017		-0.023	-0.016	-0.021
			(0.021)		(0.022)	(0.021)	(0.022)
Observations	7,500	7,500	7,500	7,500	7,500	7,500	7,500
Adjusted R-squared	0.986	0.986	0.986	0.986	0.986	0.986	0.986
FE	CZ YM	CZ YM	CZ YM	CZ YM	CZ YM	CZ YM	CZ YM
Cluster	CZ YM	CZ YM	CZ YM	CZ YM	CZ YM	CZ YM	CZ YM

Notes: This table displays the results from the regressions of the log of monthly job postings in each commuting zone on 12-month leads of the associated trade barrier exposure measures. The objective is a placebo test of whether tariff changes in 2018 also led to changes in postings in 2017. All specifications include CZ and month-year (YM) fixed effects, and standard errors (in parentheses) are two-way clustered at the CZ and month-year level. Tariff exposure measures should be interpreted in units of $1,000 dollars per worker. *** p<0.01, ** p<0.05, * p<0.1.

TABLE 2.9. ALTERNATIVE TARIFF MEASURES

Dep. var. ln(postings+1)	(1) Baseline	(2) Measure A	(3) Measure B	(4) Measure C	(5) Measure D	(6) Measure E
Output tariff exposure	-0.006	-0.006	321.573**	18.308**	60.336	55.491
	(0.015)	(0.017)	(115.224)	(8.002)	(38.180)	(36.786)
Imported input tariff exposure	-0.020***	-0.023***	-537.423***	-26.251***	-179.449***	-167.469***
	(0.007)	(0.008)	(136.898)	(7.395)	(59.739)	(56.295)
Export tariff exposure	-0.120***	-0.134***	-901.142***	-24.485**	-316.631***	-293.994***
	(0.036)	(0.043)	(265.394)	(8.866)	(90.154)	(81.838)
Total ag subsidy	0.001*	0.001*	0.002**	0.002*	0.002*	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ag subsidy *	-0.000	-0.001	-1.982**	-0.120	-0.899	-0.808
Export tariff exposure	(0.000)	(0.001)	(0.867)	(0.081)	(0.769)	(0.579)
Observations	14,640	14,640	14,640	14,640	14,640	14,640
Adjusted R-squared	0.977	0.977	0.977	0.977	0.977	0.977
FE	CZ YM	CZ YM	CZ YM	CZ YM	CZ YM	CZ YM
Cluster	CZ YM	CZ YM	CZ YM	CZ YM	CZ YM	CZ YM

Notes: This table displays the results from the regressions of the log of monthly job postings in each commuting zone on the associated trade barrier exposure measures. The definitions of each of the tariffs measures are presented in Section 2.6.2. All specifications include CZ and month-year (YM) fixed effects, and standard errors (in parentheses) are two-way clustered at the CZ and month-year level. Tariff exposure measures should be interpreted in units of $1,000 dollars per worker and agricultural subsidies in units of $1,000,000. *** p<0.01, ** p<0.05, * p<0.1.

Alternative tariff measure definitions

This section presents the full definitions of the alternative tariff measures discussed in Section 2.6.2. For simplicity I present only the output tariff exposure measures, but the other measures are analogous. The superscripts link these definitions to the columns in Table 2.9.

The first alternative measure adjusts the sectoral tariff exposure by log-transforming the tariff rate:

$$\text{output tariff exposure}_{j,t}^{(A)} = \frac{\sum_{c,p \in j} \text{US imports}_{pc,2016} \times \ln(1 + \text{US tariff}_{pc,t})}{\text{L}_{j,2015}} \quad (2.7)$$

The second measure instead applies the log transformation to the baseline sectoral exposure measure after weighting by trade values and national employment:

$$\text{output tariff exposure}_{r,t}^{(B)} = \ln\left(1 + \frac{\sum_{c,p \in j} \text{US imports}_{pc,2016} \times \text{US tariff}_{pc,t}}{\text{L}_{j,2015}}\right) \quad (2.8)$$

The third measure is also presented in the main text and weights by trade shares instead of national employment as follows:

$$\text{output tariff exposure}_{j,t}^{(C)} = \frac{\sum_{c,p \in j} \text{US imports}_{cp,2016} \times \ln(1+\text{import tariff}_{cpt})}{\text{US imports}_{j,2016}} \quad (2.9)$$

The fourth measure additionally multiplies by the the sectoral share of imports in output, where output is defined as domestic shipments plus imports minus exports as in Amiti et al. (2019):

$$\begin{aligned} \text{output tariff exposure}_{j,t}^{(D)} = \frac{\text{US imports}_{j,2016}}{\text{Output}_{j,2016}} \times \\ \frac{\sum_{c,p \in j} \text{US imports}_{cp,2016} \times \ln(1+\text{import tariff}_{cpt})}{\text{US imports}_{j,2016}} \end{aligned} \quad (2.10)$$

Finally, the fifth measure applies the log transformation after the import weighting and then multiplies again by the import share:

$$\begin{aligned} \text{output tariff exposure}_{j,t}^{(E)} = \frac{\text{US imports}_{j,2016}}{\text{Output}_{j,2016}} \times \\ \ln\left(1 + \frac{\sum_{c,p \in j} \text{US imports}_{cp,2016} \times \text{import tariff}_{cpt}}{\text{US imports}_{j,2016}}\right) \end{aligned} \quad (2.11)$$

[The chapter originally presented here cannot be made freely available via ORA because of copyright.]

Conclusion

This thesis provides evidence on two key topics relating to the tension between national policy and international cooperation.

The first topic covers the relationship between trade barriers and local labour demand, as proxied by online job postings. The analysis relates to the national trade policies of certain prominent countries which have recently deviated from the long-term trend of increased global integration and cooperation. Chapter 1 concentrates on the effects of potential future trade barriers, with a focus on services trade barriers, in the context of the Brexit referendum and the subsequent extended negotiation period and uncertainty about the long-term future relationship between the UK and the EU. The evidence shows that the prospect of barriers to professional services trade negatively impacted job postings, and that the effect was stronger after the middle of 2018, and in months with greater uncertainty surrounding the future relationship. There was no effect found for trade barriers on goods however, despite the comparative importance of this rhetoric in the media and national discourse.

Chapter 2 looks at actual applied tariffs rather than potential future trade barriers, in the context of the US-led tariff increases of 2018. Here the evidence shows that large trade barriers on goods did indeed have a meaningful effect on local labour demand with negative impacts coming from the increased cost of imported inputs and retaliatory tariffs on US exports. There is no evidence, however, of a compensatory positive effect coming from protection of US industries.

The difference in results between the Brexit and US chapters could be due to several factors. First, after decades of negotiations to reduce tariffs on goods, the current EU MFN tariffs are generally low, with a trade weighted average of 3 percent across products, and hence the tariff 'threat' under a no deal may not be large

enough to affect firms' behaviour in advance of the final deal. Alternatively, firms may have strongly believed that a free trade agreement, with zero tariffs on the vast majority of products, would be reached and hence the probability of facing these tariffs was minimal. It appears that the perceived likelihood of reaching a trade agreement on services was much lower, partially due to rhetoric from EU and UK negotiators, and partly due to a realisation of how difficult agreements on services are in general to finalise.

In the case of the US trade war, the tariff rates imposed were very high, reaching 25 percent on many products. Furthermore, throughout 2018 it was unclear just how high tariffs might end up, whereas the UK-EU tariff rates were very likely capped at the MFN rates. It may therefore be that firms can cope with relatively small changes in tariffs, perhaps due a built-in buffer on profit margins to account for fluctuations in the business environment or exchange rate.

There are several future avenues to explore between trade barriers and local labour demand. The job postings data contain extensive information beyond that used in this research. More sophisticated text analysis may make it possible to better filter the postings into, for example, categories that signify firm movements toward automation or greater usage of artificial intelligence in certain sectors. It would also be beneficial to improve our understanding of the relationship between job postings, labour demand, hiring, and employment, as well as differences between online and offline job postings, and intra-firm hiring versus public job postings. As data from more countries becomes available, it may be possible to explore the network effects of job postings, for example, increases in postings in Paris and Frankfurt directly relating to decreases in financial services postings in London. The ability to accurately map these postings to other firm-specific variables would also be of great interest. Given the near real-time nature of this data, along with very high frequency, it has the potential to provide insights into short term responses to stimulus that are not possible with more standard official data sources.

There remains significant progress to be made on understanding the impact of trade uncertainty on important outcomes such as trade flows, employment, GDP and inequality. Better measures of economic uncertainty could be built into national surveys with the aim of providing long term time series of perceptions of

the likelihood of different economic outcomes. The Brexit Decision Makers Panel represents a key step in this direction but was started three months after the referendum and remains limited in detail. An extension of the current papers could be to continue the Brexit analysis into the post-deal period when future trade barriers are known, and to add an uncertainty component to the US analysis. The latter could be achieved by considering the effects of tariffs that have been announced but not implemented, as well as those that have been implemented.

All of the results presented for the first topic represent short-term responses, but it is as yet unclear how these effects will propagate into the future. Once clarity is provided about the likely state of future barriers, it would be interesting to explore whether job postings return to previous levels, even if the barriers are higher than before. It could even be possible that firms expand hiring above previous levels for a period to fill job openings that remained empty during the period of uncertainty.

The second topic in this thesis looks at the relationship between foreign direct investment and tax policy. The analysis uses a panel dataset covering 22 sectors, 159 countries, and 7 years (2009-2015) to study how corporate tax rates and tax holidays impact inward FDI. [The text originally presented here cannot be made freely available via ORA because of copyright.]

There are several avenues of possible future research for this topic. One straightforward development of the paper would be to augment the dataset coverage with more years. Given the specification used, identification of the key parameters relies on within-country variation over time, and the degree to which this varies across countries. It would therefore be beneficial to extend the length of this panel dataset to include the largest number of policy changes possible. The data could also be developed to include more information on the base upon which the tax is levied, for example the range of tax allowances, in order to make estimation of the effective average tax rate and the effective marginal tax rate possible. To increase precision, data on ad hoc or project specific incentives would be advantageous. Some progress is being made through the Wavteq IncentivesFlow database but questions remain about how representative the data is. Aside from the tax data, it would be beneficial to improve information about greenfield FDI projects,

including accurate investment values which take into account real spending over time as opposed to initial announced values which are estimates by the investors and may be spread over several years. Future work could also concentrate on modelling more explicitly the distinction between the impact of tax policy on the decision to invest or not invest, versus the size of each individual investment. In other words, conditional on investing, do investors invest more or create more jobs when tax policy is more favourable?

Evidence from these three chapters contributes to our understanding of the effectiveness of following these national, unilateral policies on trade and taxation. The United Kingdom's separation from the European Union, the United States' implementation of high import tariffs and the retaliatory tariffs on US exports, as well as the application of low taxes to attract investment away from other countries are examples of prioritising national goals over international cooperation. In the case of UK and US trade policy, the evidence seems to point to negative impacts on labour demand. [The text originally presented here cannot be made freely available via ORA because of copyright.]. It seems likely, therefore, that the case for international cooperation in these areas remains convincing even when targeting national goals.

References

Ahir, Hites, Nicholas Bloom, and Davide Furceri, "The World Uncertainty Index," *SSRN Electronic Journal*, 2018.

Allen, N.J., Jacques Morisset, Neda Pirnia, and L.T. Wells, *Using Tax Incentives to Compete for Foreign Investment: Are They Worth the Costs?*, The World Bank, January 2001.

Amiti, M. and S.-J. Wei, "Fear of service outsourcing: is it justified?," *Economic Policy*, April 2005, *20* (42), 308–347.

Amiti, Mary, Stephen J. Redding, and David E. Weinstein, "The Impact of the 2018 Tariffs on Prices and Welfare," *Journal of Economic Perspectives*, November 2019, *33* (4), 187–210.

Arnold, Jens M., Beata S. Javorcik, and Aaditya Mattoo, "Does services liberalization benefit manufacturing firms?," *Journal of International Economics*, September 2011, *85* (1), 136–146.

Arnold, Jens Matthias, Beata Javorcik, Molly Lipscomb, and Aaditya Mattoo, "Services Reform and Manufacturing Performance: Evidence from India," *The Economic Journal*, February 2016, *126* (590), 1–39.

Autor, David, David Dorn, Gordon Hanson, and Kaveh Majlesi, "Importing Political Polarization? The Electoral Consequences of Rising Trade Exposure," Technical Report w22637, National Bureau of Economic Research, Cambridge, MA 2020.

Autor, David H., "Trade and labor markets: Lessons from China's rise," *IZA World of Labor*, 2018.

_ , David Dorn, and Gordon H. Hanson, "The China Syndrome: Local Labor Market Effects of Import Competition in the United States," *American Economic Review*, October 2013, *103* (6), 2121–2168.

_ , _ , and _ , "The China Shock: Learning from Labor-Market Adjustment to Large Changes in Trade," *Annual Review of Economics*, October 2016, *8* (1), 205–240.

_ , _ , _ , and Jae Song, "Trade Adjustment: Worker-Level Evidence," *Quarterly Journal of Economics*, November 2014, *129* (4), 1799–1860.

Baker, Scott R., Nicholas Bloom, and Steven J. Davis, "Measuring Economic Policy Uncertainty," *The Quarterly Journal of Economics*, November 2016, *131* (4), 1593–1636.

Baldwin, Richard, *The Great Convergence: Information Technology and the New Globalization*, Harvard University Press, 2016.

Barone, Guglielmo and Federico Cingano, "Service Regulation and Growth: Evidence from OECD Countries," *The Economic Journal*, September 2011, *121* (555), 931–957.

Bellak, Christian, Markus Leibrecht, and Jože P. Damijan, "Infrastructure Endowment and Corporate Income Taxes as Determinants of Foreign Direct Investment in Central and Eastern European Countries," *World Economy*, February 2009, *32* (2), 267–290.

Bernanke, Ben S., "Irreversibility, Uncertainty, and Cyclical Investment," *The Quarterly Journal of Economics*, February 1983, *Volume 98* (Issue 1), 85–106.

Bernhofen, Daniel M and John C Brown, "An Empirical Assessment of the Comparative Advantage Gains from Trade: Evidence from Japan," *American Economic Review*, February 2005, *95* (1), 208–225.

Beverelli, Cosimo, Matteo Fiorini, and Bernard Hoekman, "Services trade policy and manufacturing productivity: The role of institutions," *Journal of International Economics*, January 2017, *104*, 166–182.

Blanchard, Emily J, Chad P Bown, and Davin Chor, "Did Trump's Trade War Impact the 2018 Election?," *NBER Working Paper*, November 2019, *26434.*

Blanchard, Pierre, Emmanuel Dhyne, Catherine Fuss, and Claude Mathieu, "(Not So) Easy Come, (Still) Easy Go? Footloose Multinationals Revisited," *World Economy*, May 2016, *39* (5), 679–707.

Bloom, Nicholas, "The Impact of Uncertainty Shocks," *Econometrica*, 2009, *77* (3), 623–685.

_ , Philip Bunn, Scarlet Chen, Paul Mizen, Pawel Smietanka, Greg Thwaites, and Garry Young, "Brexit and uncertainty: insights from the Decision Maker Panel," *Bank of England, Staff Working Paper No. 780*, February 2019.

Bond, Eric W and Larry Samuelson, "Tax Holidays as Signals," *American Economic Review*, 1986, *76* (4), 820–826.

Bown, C and M Kolb, "Trump's Trade War: An Up-to-Date Guide.," *Peterson Institute for International Economics*, 2019.

Breinlich, Holger, Anson Soderbery, and Greg C. Wright, "From Selling Goods to Selling Services: Firm Responses to Trade Liberalization," *American Economic Journal: Economic Policy*, November 2018, *10* (4), 79–108.

_ , Elsa Leromain, Dennis Novy, and Thomas Sampson, "Voting with Their Money: Brexit and Outward Investment by UK Firms," *CESifo Working Paper no. 7751*, July 2019.

Bénassy-Quéré, Agnès, Lionel Fontagné, and Amina Lahrèche-Révil, "How Does FDI React to Corporate Taxation?," *International Tax and Public Finance*, September 2005, *12* (5), 583–603.

Cavallo, Alberto, Gita Gopinath, Brent Neiman, and Jenny Tang, "Tariff Passthrough at the Border and at the Store: Evidence from US Trade Policy," *NBER Working Paper*, 2019, (26396).

Costa, Rui, Swati Dhingra, and Stephen Machin, "Trade and Worker Deskilling," *CEP Discussion Paper Series*, 2019.

Crinò, Rosário, "Service Offshoring and White-Collar Employment," *The Review of Economic Studies*, 2010, *77* (2), 595–632.

Crowley, Meredith A, ed., "Trade war: the clash of economic systems endangering global prosperity," *Centre for Economic Policy Research*, 2019.

Crowley, Meredith, Ning Meng, and Huasheng Song, "Tariff scares: Trade policy uncertainty and foreign market entry by Chinese firms," *Journal of International Economics*, September 2018, *114*, 96–115.

_ , Oliver Exton, and Lu Han, "Renegotiation of Trade Agreements and Firm Exporting Decisions: Evidence from the Impact of Brexit on UK Exports," *Cambridge Working Papers in Economics 1839*, 2018.

de Mooij, Ruud A. and Sjef Ederveen, "Corporate tax elasticities: a reader's guide to empirical findings," *Oxford Review of Economic Policy*, 2008, *24* (4), 680–697.

Deming, David and Kadeem Noray, "Earnings Dynamics, Changing Job Skills, and STEM Careers," *The Quarterly Journal of Economics*, 2020, *135* (4).

_ and Lisa B Kahn, "Skill Requirements across Firms and Labor Markets: Evidence from Job Postings for Professionals," *Journal of Labor Economics*, 2018, *36* (S1).

Desai, Mihir A., Fritz C. Foley, and James R. Hines Jr., "Taxation and Multinational Activity: New Evidence, New Interpretations.," *Survey of Current Business*, February 2006, *86* (2), 16–22.

Devereux, M. P., R. Griffith, and A. Klemm, "Corporate income tax reforms and international tax competition," *Economic Policy*, October 2002, *17* (35), 449–495.

Devereux, Michael P., Ben Lockwood, and Michela Redoano, "Do countries compete over corporate tax rates?," *Journal of Public Economics*, June 2008, *92* (5-6), 1210–1235.

Dhingra, Swati, Hanwei Huang, Gianmarco Ottaviano, João Paulo Pessoa, Thomas Sampson, and John Van Reenen, "The costs and benefits of leaving the EU: trade effects," *Economic Policy*, October 2017, *32* (92), 651–705.

Dixit, Avinash K and Robert S Pindyck, *Investment under uncertainty*, Princeton, N.J.: Princeton University Press, 1994.

Ebell, Monique, "Assessing the Impact of Trade Agreements on Trade," *National Institute Economic Review*, November 2016, *238*, R31–R42.

Eckert, Fabian, Teresa C. Fort, Peter K. Schott, and Natalie J. Yang, "Imputing Missing Values in the US Census Bureau's County Business Patterns.," *NBER Working Paper*, 2020, (#26632).

Edmonds, Eric V, Nina Pavcnik, and Petia Topalova, "Trade Adjustment and Human Capital Investments: Evidence from Indian Tariff Reform," *American Economic Journal: Applied Economics*, October 2010, *2* (4), 42–75.

Egger, Peter, Simon Loretz, Michael Pfaffermayr, and Hannes Winner, "Bilateral effective tax rates and foreign direct investment," *International Tax and Public Finance*, December 2009, *16* (6), 822–849.

Eppinger, Peter S., "Service offshoring and firm employment," *Journal of International Economics*, March 2019, *117*, 209–228.

Fajgelbaum, Pablo D, Pinelopi K Goldberg, Patrick J Kennedy, and Amit K Khandelwal, "The Return to Protectionism," *The Quarterly Journal of Economics*, February 2020, *135* (1), 1–55.

Fetzer, Thiemo, "Did Austerity Cause Brexit?," *American Economic Review*, November 2019, *109* (11), 3849–3886.

Feyrer, James, "Distance, Trade, and Income - The 1967 to 1975 Closing of the Suez Canal as a Natural Experiment," Technical Report w15557, National Bureau of Economic Research, Cambridge, MA December 2009.

_ , "Trade and Income—Exploiting Time Series in Geography," *American Economic Journal: Applied Economics*, October 2019, *11* (4), 1–35.

Flaaen, Aaron, Ali Hortaçsu, and Felix Tintelnot, "The Production Relocation and Price Effects of US Trade Policy: The Case of Washing Machines," *American Economic Review*, July 2020, *110* (7), 2103–2127.

_ and Justin Pierce, "Disentangling the Effects of the 2018-2019 Tariffs on a Globally Connected U.S. Manufacturing Sector," *Finance and Economics Discussion Series*, December 2019, (086).

Fowler, Christopher S, Leif Jensen, and Danielle C Rhubart, "Assessing U.S. Labor Market Delineations for Containment, Economic Core, and Wage Correlation," *Working Paper*, 2016.

Frankel, Jeffrey A and David Romer, "Does Trade Cause Growth?," *American Economic Review*, June 1999, *89* (3), 379–399.

Gervais, Antoine and J. Bradford Jensen, "The tradability of services: Geographic concentration and trade costs," *Journal of International Economics*, May 2019, *118*, 331–350.

Gordon, Roger H, "Taxation of Investment and Savings in a World Economy," *American Economic Review*, 1986, *76.*

Graziano, Alejandro, Kyle Handley, and Nuno Limão, "Brexit Uncertainty and Trade Disintegration," *NBER Working Paper*, December 2018, (25334).

Hallerberg, Mark and Scott Basinger, "Internationalization and Changes in Tax Policy in OECD Countries: The Importance of Domestic Veto Players," *Comparative Political Studies*, June 1998, *31* (3), 321–352.

Handley, Kyle and Nuno Limão, "Policy Uncertainty, Trade, and Welfare: Theory and Evidence for China and the United States," *American Economic Review*, September 2017, *107* (9), 2731–2783.

Hassler, John A.A., "Variations in risk and fluctuations in demand: A theoretical model," *Journal of Economic Dynamics and Control*, June 1996, *20* (6-7), 1115–1143.

Hebous, Shafik, Martin Ruf, and Alfons Weichenrieder, "The Effects of Taxation on the Location Decision of Multinational Firms: M&A Versus Greenfield Investments," *National Tax Journal;*, September 2011, *64* (3), 817–838.

Hershbein, Brad and Lisa B. Kahn, "Do Recessions Accelerate Routine-Biased Technological Change? Evidence from Vacancy Postings," *American Economic Review*, July 2018, *108* (7), 1737–1772.

Hunady, Jan and Marta Orviska, "Determinants of Foreign Direct Investment in EU Countries – Do Corporate Taxes Really Matter?," *Procedia Economics and Finance*, 2014, *12*, 243–250.

Irwin, Douglas A, "Trade Policy in American Economic History," *Annual Review of Economics*, 2020, *12.*

James, Sebastian, *Incentives and Investments: Evidence and Policy Implications*, World Bank, December 2009.

_ and Stefan Van Parys, "The effectiveness of tax incentives in attracting investment: panel data evidence from the CFA Franc zone," *International Tax and Public Finance*, August 2010, *17* (4), 400–429.

Jensen, J Bradford and Lori Kletzer, "Tradable Services: Understanding the Scope and Impact of Services Outsourcing," *Peterson Institute for International Economics*, September 2005, *Working Paper* (05-9).

King, M. and D. Fullerton, *The Taxation of income from capital: A comparative study of the United States, the United Kingdom, Sweden and West Germany*, University of Chicago Press, 1984.

Klemm, Alexander and Stefan Van Parys, "Empirical evidence on the effects of tax incentives," *International Tax and Public Finance*, June 2012, *19* (3), 393–423.

Liu, Runjuan and Daniel Trefler, "A sorted tale of globalization: White collar jobs and the rise of service offshoring," *Journal of International Economics*, May 2019, *118*, 105–122.

Mattoo, Aaditya, Nadia Rocha, and Michele Ruta, "The Evolution of Deep Trade Agreements," *World Bank Policy Research Working Paper 9283*, 2020.

Mayer, Thierry, Vincent Vicard, and Soledad Zignago, "The Cost of Non-Europe, Revisited," *Economic Policy*, 2019, *34* (98), 145–199.

Mulabdic, Alen, Alberto Osnago, and Michele Ruta, "Deep Integration and UK-EU Trade Relations," *World Bank Working Paper*, 2017.

New Financial, "Report: Brexit & the City - the impact so far," March 2019.

ONS, "International trade in services," 2018.

_ , "UK Balance of Payments, The Pink Book: 2019," 2019.

O'Rourke, Kevin Hjortshøj, "Two Great Trade Collapses: The Interwar Period & Great Recession Compared," Technical Report w23825, National Bureau of Economic Research, Cambridge, MA September 2017.

Overesch, Michael and Georg Wamser, "Who Cares About Corporate Taxation? Asymmetric Tax Effects on Outbound FDI," *World Economy*, December 2009, *32* (12), 1657–1684.

Pierce, Justin R. and Peter K. Schott, "The Surprisingly Swift Decline of US Manufacturing Employment," *American Economic Review*, July 2016, *106* (7), 1632–1662.

PricewaterhouseCoopers, "Tax policy and administration: Global Trends," 2012.

Sauvant, Karl P, "Beware of FDI statistics," *Columbia FDI Perspectives*, 2017.

Silva, J.M.C. Santos and Silvana Tenreyro, "On the existence of the maximum likelihood estimates in Poisson regression," *Economics Letters*, May 2010, *107* (2), 310–312.

Slemrod, Joel, "The Economics of Corporate Tax Selfishness," *National Tax Journal*, 2004, *57* (4), 877–899.

Swank, Duane, "Tax Policy in an Era of Internationalization: Explaining the Spread of Neoliberalism," *International Organization*, October 2006, *60* (04).

Topalova, Petia, "Factor Immobility and Regional Impacts of Trade Liberalization: Evidence on Poverty from India," *American Economic Journal: Applied Economics*, October 2010, *2* (4), 1–41.

United Nations Conference on Trade and Development, *World Investment Report 2016: Investor Nationality - Policy Challenges* United Nations Conference on Trade and Development (UNCTAD) World Investment Report (WIR), UN, June 2016.

Waugh, Michael, "The Consumption Response to Trade Shocks: Evidence from the US-China Trade War," Technical Report w26353, National Bureau of Economic Research, Cambridge, MA October 2019.

Whaples, Robert, "Where Is There Consensus Among American Economic Historians? The Results of a Survey on Forty Propositions," *The Journal of Economic History*, 1995, *55* (1), 139–154.