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HUANG, Hanwei
City University of Hong Kong

SENGA, Tatsuro
RIETI

THOMAS, Catherine
London School of Economics and Political Science

ZHANG, Hongyong
RIETI

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Economic Disintegration and Multinational Production: Evidence from Brexit*

Hanwei Huang **Tatsuro Senga** **Catherine Thomas** **Hongyong Zhang**†

Abstract

Using microdata on Japanese multinational enterprises (MNEs) from 2010 to 2019, we examine the impact of Brexit on global production networks and supply chains. Specifically, we conduct a difference-in-differences analysis and compare the performance of Japanese foreign affiliates in the United Kingdom (UK) and other European Union (EU) countries before and after the 2016 Brexit referendum. We obtained the following three findings. First, Brexit significantly decreased the total sales of Japanese affiliates in the UK by approximately 11%. Their sales dropped because of lower local sales in the UK and exports, especially to other European countries. The impact of Brexit on Japanese affiliates' total sourcing in the UK was even larger (approximately 14%), especially for their local purchases and imports from the European market. Second, Japanese foreign affiliates in the UK decreased their employment, number of Japanese expatriates, and capital investment after Brexit. At the same time, the productivity and profitability of Japanese affiliates decreased and their probability of exiting the UK increased significantly. Third, the negative impact of Brexit was larger in non-manufacturing industries than in manufacturing industries, suggesting much higher trade costs in service trade. Our findings suggest that a substantial increase in (uncertainty over) trade costs due to institutional changes may reshape global production networks and supply chains.

Keywords: Multinationals, Global Supply Chains, Production Networks, Brexit, Service Trade
JEL classification: F14, F23,

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† **Huang**: City University of Hong Kong, huang.hanwei@cityu.edu.hk. **Senga**: Keio University and RIETI, t.senga@keio.jp. **Thomas**: London School of Economics and Political Science, c.m.thomas@lse.ac.uk. **Zhang**: RIETI, zhang-hong-yong@rieti.go.jp.

1. Introduction

In June 2016, the Brexit referendum led to the unprecedented dissolution of deep economic integration in Europe. This meant a rise in trade costs, multinational enterprises (MNEs) no longer enjoying free movement of goods, services, capital, and people across the borders of the United Kingdom (UK), and more stringent regulations and higher production costs for the European Union (EU) members and affiliates. For MNEs, part of the UK's attractiveness is its easy access to the European EU's Single Market. After Brexit, higher trade costs with the EU would likely depress foreign direct investment (FDI) (Dhingra, Ottaviano, Sampson, and Van Reenen, 2016). While most of the literature focuses on the impact of Brexit on UK-EU trade, we examine the impact of Brexit on a third country, Japan. The UK is one of the most important destinations for outward FDI in Japan. At the end of 2015, the UK accounted for 31% of Japan's outward FDI stock in the EU and 7% of Japan's total outward FDI stock.[1] Moreover, in 2015, Japanese affiliates employed approximately 160 thousand workers in the UK and 340 thousand workers in the rest of the EU.[2]

This study sheds light on the impact of the 2016 Brexit referendum on MNEs using micro-data from government surveys conducted by the Japanese Ministry of Economy, Trade and Industry (METI). Our data include extensive firm-level information on Japan's foreign affiliates in manufacturing and non-manufacturing sectors. Compared to data from other countries, the Japanese data stand out for their fine breakdown of sales and purchases by destination (Local, Japan, Europe, Asia, North America, and other regions) for each foreign affiliate. This decomposition is particularly interesting for exploring the sales-sourcing patterns of MNEs and the potential impact of trade policies on multinational production.[3] The data cover more than 40,000 foreign affiliates in the UK, EU, and the rest of the world (ROW) between 2010 and 2019. Using a difference-in-differences (DID) approach, we estimate the impact of Brexit on the sales-sourcing patterns, firm behaviors (hiring, investment, entry, and exit), and firm performance (productivity and profitability) of Japanese affiliates.

Overall, this study has three important findings. First, relative to the Japanese affiliates in the EU

[1] Source: Japanese Ministry of Finance and Bank of Japan.
[2] Source: Basic Survey of Overseas Business Activities (BSOBA), Japanese Ministry of Economy, Trade and Industry (METI).
[3] Kondo (2018) investigates the sourcing patterns of Japanese export-platform foreign affiliates in Mexico, which mainly export to the United States and Canada. Sun, Tao, Yuan, and Zhang (2019) examine the impact of the US-China trade war on the performance of Japanese affiliates in China with high exposure to trade with North America.

(control group), Brexit significantly decreased the total sales of Japanese affiliates in the UK (treatment group) by approximately 11%.[4] Their sales dropped because of lower local sales in the UK and exports to other European countries. The impact of Brexit on Japanese affiliates total sourcing (purchases) in the UK was even larger (approximately 14%), especially for their local purchases and imports from the European market.[5] Second, after Brexit, Japanese foreign affiliates in the UK decreased their employment, Japanese expatriates, and capital investments relative to their Japanese affiliates in the EU. At the same time, the productivity and profitability of Japanese affiliates significantly decreased and their probability of exiting the UK significantly increased by 1.1% points. Third, interestingly, we find that the negative impact of Brexit is larger in non-manufacturing industries than in manufacturing industries, suggesting higher trade costs in services trade than in goods trade. Our findings suggest that a substantial increase in (uncertainty over) trade costs due to institutional changes may reshape global production networks and supply chains.

Although this study provides new evidence on how Brexit affects trade and multinational production at the firm level, our results should be interpreted carefully. It is important to note that although the UK voted to leave the EU in June 2016, its economic relationship with the union did not change until January 1, 2021, when the EU-UK Trade and Cooperation Agreement (TCA) came into effect (Freeman, Manova, Prayer and Sampson, 2022). Therefore, the overall negative impact of Brexit on Japanese affiliates in the UK observed in our data probably comes mainly from a large and persistent uncertainty shock–that is, the Brexit process.[6] As Bloom, Bunn, Chen, Mizen, Smietanka, and Thwaites (2019) shown, the 2016 Brexit referendum has generated a large, broad, and long-lasting increase in uncertainty and gradually reduced the investment and productivity of UK firms over the three years following the vote.[7] Furthermore, using product-level trade data, previous studies (Crowley, Exton, and Han, 2020; Graziano, Handley and Limão, 2021) found that products and firms that are more exposed to trade policy uncertainty (the threat of tariff hikes under preferential trade disagreements) experienced lower trade growth before and immediately after the referendum.

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[4] The negative impact was even larger if we use alternative control groups. Specifically, relative to all foreign affiliates outside the UK, total sales declined by approximately 22%.

[5] We use purchases and sourcing interchangeably through the paper.

[6] Three years after the vote, the UK had not left the EU, and there was great unsolved uncertainty over the eventual outcome until 2020.

[7] In addition, more productive, internationally exposed, firms have been more negatively impacted than less productive domestic firms.

Our study is closely related to nascent Brexit literature. First, it contributes to the literature on the effects of Brexit-associated uncertainty and policy changes on FDI. Dhingra, Ottaviano, Sampson, and Van Reenen (2016) predicted FDI might fall if the UK left the EU because of (i) large costs from tariff and non-tariff barriers for export platform FDI in the UK, (ii) difficulties of co-ordination of production network and supply chains, and (iii) uncertainty over the trade agreement between the UK and the EU.[8] Using simulations from a multi-country neoclassical growth model, McGrattan and Waddle (2020) analyzed the impact of Brexit on foreign investment and production based on several post-Brexit scenarios. However, ex-post analyses of MNEs and FDI using firm-level data are rare. Cieślik and Ryan (2022) are an exception and they find a negative relationship between the Brexit announcement and decreased FDI (count of newly established Japanese affiliates) in the UK.[9] By contrast, we use the most comprehensive data (both annual and quarterly) on the activities of Japanese foreign affiliates and provide new evidence on the impact of Brexit on various outcome variables (both firm behavior and firm performance) at the firm (affiliate) level.

Second, we contribute to the literature on the trade effects of Brexit. These studies include ex-ante simulations based on the general equilibrium model and country-product (sector)-level trade data (e.g., Dhingra, Huang, Ottaviano, Pessoa, Sampson, and Van Reenen, 2017; Steinberg, 2019) and ex-post analysis using trade data at the product or firm-product level (Crowley, Exton, and Han, 2020; Graziano, Handley, and Limão, 2021; Freeman, Manova, Prayer, and Sampson, 2022). These studies find that Brexit has a large negative impact on trade and welfare.[10] However, to the best of our knowledge, no study has examined the trade effects of Brexit on multinational production at the firm level. This is important because MNEs account for a large share of the world's output, exports, and employment (Antras and Yeaple, 2014).

Third, our study is also linked to studies on the impact of Brexit on firm behavior and performance. Bloom, Bunn, Chen, Mizen, Smietanka, and Thwaites (2019) find that the Brexit process is

[8] Dhingra, Ottaviano, Rappoport, Sampson, and Thomas (2018) point out that Brexit is likely to make the UK poorer by reducing trade and investment flows, but the magnitude of the economic decline will depend upon the nature of the UK's post-Brexit economic relations with the EU and the rest of the world.

[9] They use the Overseas Japanese Companies (OJC) database collected by Toyo Keizai (a private company in Japan). This data only contains limited information on foreign affiliates such as founding year, ownership structure, the number of employees, location, and industry affiliation.

[10] Du and Shepotylo (2022) examine the impact of Brexit on the UK's services trade. More generally, Sampson (2017) and Porters (2022) provide comprehensive discussion and evidence on the impact of Brexit on the macroeconomy, international trade, FDI, immigration, and labour market.

estimated to have reduced UK firms' investment by 11% and productivity by 2%-5%. Furthermore, Campello, M., G., Cortes, d'Almeida, and G. Kankanhalli (2022) find that UK-exposed US firms with less re-deployable capital and high input-offshoring dependence cut their domestic investment after 2016. By contrast, we find an approximately 5.9% decline in capital investment and a 7.1% decline in the productivity of Japanese affiliates. We complement the literature by focusing on the impact of Brexit on the global activities and performance of MNEs.

The remainder of this paper is organized as follows. Section 2 describes the data on Japanese foreign affiliates and Section 3 provides descriptive evidence. Section 4 presents the DID estimation results of Brexit's impact on the sales-sourcing patterns, firm behaviors, and performance of Japanese foreign affiliates. Finally, section 5 concludes the study.

2. Data

Our empirical analysis relied on two government surveys conducted by the Japanese Ministry of Economy, Trade and Industry (METI). Our main dataset is the annual Basic Survey on Overseas Business Activities (BSOBA), covering the period 2010-2019 fiscal year. These data have been used elsewhere to study the trade and investment of Japanese foreign affiliates in manufacturing and non-manufacturing sectors (e.g., Baldwin and Okubo, 2014; Spinelli, Rouzet, and Zhang, 2020). This survey is mandatory and is conducted annually via self-declaration survey forms (one for the parent firm and another for each foreign affiliate) sent to the parent firm at the end of each fiscal year.[11] The survey form for parent firms includes variables on the firm's domestic sales, employment, industry classifications, and so on, whereas the survey for foreign affiliates collects information on their sales, purchases, employment, investment, location, and industry.[12] Based on the annual survey, we construct a panel dataset of parent–affiliate pairs from 2010 to 2019, which includes both manufacturing and non-manufacturing firms. Our full sample comprises 10,759 parent firms and 42,887 foreign affiliates in 124 host countries.

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[11] The survey covers two types of overseas businesses: (1) direct (first-tier) affiliated firms with more than 10% of the equity share capital owned by Japanese parent firms, and (2) second-tier affiliated firms with more than 50% of the equity share capital owned by Japanese parent firms.

[12] For a small number of parent firms (275 firm-year observations in our sample), they do not report their sales in this survey because they are also requested to report their sales in another government survey, the Basic Survey of Japanese Business Structure and Activities (BSJBSA) conducted by the METI. In this case, we use the BSJBSA to complete the information on the sales of parent firms. The BSJBSA covers both multinational firms and non-multinational firms in Japan. The scope of this survey covers enterprises with 50 or more employees and whose paid-up capital or investment fund is over 30 million yen, whose operation falls under the mining, manufacturing, wholesale and retail trade, and eating and drinking places, other industries such as electricity and gas service, and information service.

In the survey, each affiliate reported a detailed decomposition of its total sales and total sourcing by major regions. Specifically, total sales are decomposed into local sales, exports to Japan, and exports to other countries. Similarly, total sourcing is decomposed into local purchases, imports from Japan, and imports from other countries. Importantly, exports to (and imports from) third countries can be further divided into those to (imports from) Europe, North America, Asia, and other regions.[13] Note that purchases do not concern factors of production, such as labor, capital, and technology. Affiliates also report their founding year and operational status, including dissolution, withdrawal, or decline in control shares, which allows us to precisely define entry and exit (divestment).[14] Using this panel data, we can explore the sourcing and sales patterns of Japanese foreign affiliates and compare the performance of foreign affiliates in the UK and EU (and in the ROW in the Appendix) before and after Brexit in 2016.

Our second dataset is the Quarterly Survey of Overseas Subsidiaries (QSOS) conducted by METI, covering the period from Q1 2020 to Q3 2020. The purpose of this survey was to capture the dynamic changes in the overseas activities of Japanese MNEs and promote flexible policymaking for the Japanese government and economy. This survey covers overseas affiliates in the manufacturing sector with 50 or more employees and 50% or more of their capital coming from parent companies.[15] The data contain information on sales, capital investment (acquisition of tangible fixed assets, excluding land, and depreciation), and number of employees at the end of each quarter. Similar to our annual data, sales are further divided into local sales, sales (exports) to Japan, and sales (exports) to third countries. The number of foreign affiliates was approximately 5,000 per quarter. In addition to our annual data, we use these data to conduct a supplementary analysis because (i) they have a high frequency at the quarterly level to better identify the timing of Brexit, and (ii) they cover a longer time series.

[13] Unfortunately, information on imports from (exports to) the EU are not available.
[14] Dissolution indicates that the total control share held by the Japanese corporation(s) has fallen to 0% due to dissolution (including liquidation, bankruptcy, etc.) and withdrawal indicates the sale of the business, absorption/merger, consolidation or relocation (relocation to a different country/region). Decline in control share means the total control share held by the Japanese corporation(s) has become a ratio between 0% and 10%.
[15] The survey targets parent firms that met all the following criteria: manufacturing firms with 100 million yen or more in the capital; with 50 or more employees; with overseas affiliates.

Table 1: Summary statistics of BSOBA data (2010-2019)

Variables / Samples	Full	UK	EU	Not in UK & EU but trading with Europe
Total sourcing	6543.3	7674.4	7767.7	13135.0
From local	5189.3	5965.3	5084.7	8688.1
From Japan	857.0	567.8	1540.1	2973.7
From third countries	496.6	1141.3	1142.9	1471.8
From third countries: Europe	102.3	529.0	788.5	129.8
Total sales	9759.9	11942.6	11869.1	17655.1
To local	7271.2	7974.5	8320.8	9898.7
To Japan	579.6	700.4	204.4	1742.1
To thrid countries	1908.1	3267.7	3343.8	6008.5
To third countries: Europe	359.8	2373.7	2410.0	548.4
Capital investment	293.4	381.5	234.7	460.7
Number of employees	267.8	312.4	207.8	449.9
Number of Japanese expats	2.5	2.1	1.8	4.8
Labor productivity	155.9	552.8	161.0	188.5
Profitability	0.008	0.024	0.017	0.036
Exit dummy	0.033	0.051	0.038	0.011

Notes: This figure shows the mean firm characteristics of Japanese foreign affiliates in manufacturing and non-manufacturing industries. Sourcing, sales, and investments are in millions of yen. Labor productivity is the total sales divided by number of employees. Profitability is ordinary profit divided by total sales. The number of observations is approximately 251,898 for the full sample, 6,653 for the UK sample, 20,765 for the EU sample, and 45,196 for firms not in the UK or EU but trading with Europe. Source: Authors' compilation, based on BSOBA and METI.

Table 1 presents summary statistics of the main data. On average, local purchases (local sales) account for the largest shares in total sourcing (total sales) but imports from (exports to) Japan and third countries are not negligible, suggesting the feature of "networked FDI." In networked FDI, affiliates import substantial shares of their intermediates and export substantial shares of their outputs (Baldwin and Okubo, 2014). On average, imports from and exports to third countries in the UK and the EU are much larger than those in the full sample. In the UK, imports from Japan and third countries account for 7.4% and 14.9% of total sourcing, respectively, while exports to Japan and third countries account for 5.9% and 27.4% of total sales, respectively.[16] Importantly, the share of imports from Europe in total sourcing is 6.9% in the UK (10.2% in the

[16] Similarly, in the EU, imports from Japan and third countries account for 19.8% and 14.7% of total sourcing, and exports to Japan and third countries account for 1.7% and 28.2% of total sales, respectively.

EU), and the share of exports to Europe in total sales is 19.8% in the UK (20.3% in the EU), suggesting the importance of intra-regional trade and the prevalence of regional supply chains in Europe. In addition, compared to foreign affiliates in non-UK countries, Japanese affiliates in the UK have larger investments/employment and higher productivity/profitability on average. However, UK affiliates have a slightly higher exit probability.

As Table 2 indicates, the means of quarterly sales, investment, and employment are comparable to those of the annual data. Consistent with the annual data, foreign affiliates in the UK are, on average, large firms that rely more on local sales and sales to third countries.

Table 2: Summary statistics of QSOS data (Q1 2010 – Q3 2020)

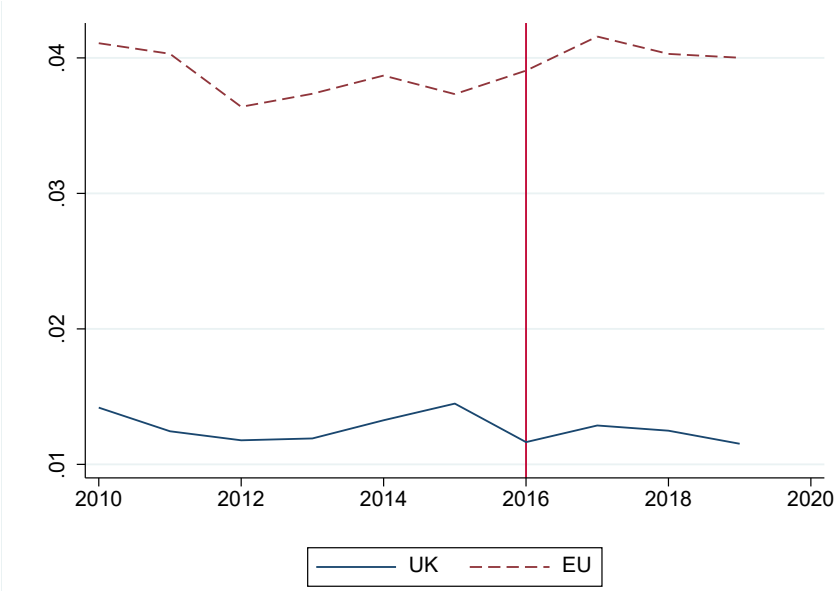
Variables / Samples	Full	UK	EU
Total sales	5671.5	9937.4	7197.2
Loca sales	4073.6	5912.2	3374.1
Sales to Japan	530.3	69.6	201.0
Sales to third countries	1067.6	3955.5	3622.1
Capital investment	175.0	240.1	187.1
Number of employees	828.5	952.4	803.3

Note: This figure shows the mean firm characteristics of Japanese foreign affiliates in the manufacturing industry. Sales and Investments are in millions of yen. There are approximately 205, 172 observations for the full sample, 3,877 for the UK sample, and 13,606 for the EU sample. Source: Authors' compilation based on the QSOS and METI.

3. Descriptive evidence

In this section, we first document the relative importance of foreign affiliates in the UK and the EU in the multinational production of Japanese MNEs. Figure 1 depicts the shares of affiliate sales of the UK and EU in the total sales of Japanese MNEs from 2010 to 2019. MNE's total sales are the sum of overseas sales (total sales of all foreign affiliates around the world) and the parent firm's total sales (sales in Japan and exports). Affiliates in the UK account for less than 2% of MNEs' total sales and affiliates in the EU account for approximately 4% of MNEs' total sales. Importantly, the UK's share declined significantly because of Brexit in 2016, but the EU's share increased significantly after Brexit. Although sales by affiliates in the UK and the EU are relatively small in terms of the total sales of Japanese MNEs, Brexit may have heterogeneous effects on the performance of foreign affiliates in the UK and the EU.

Figure 1. UK and EU's shares in Japanese MNEs' total sales

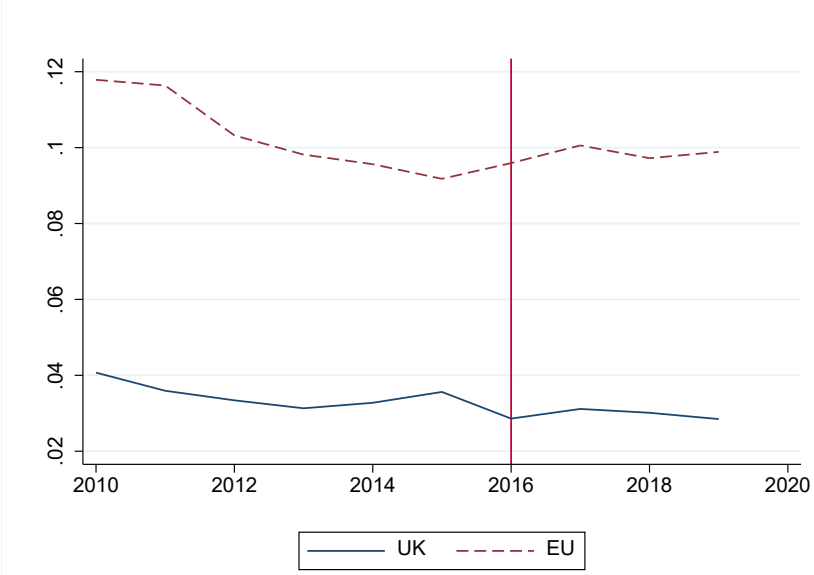


Notes: This figure shows the shares of affiliates' sales in the UK and the EU in the total sales of Japanese MNEs. MNE's sales are the sum of overseas sales (total sales of all foreign affiliates around the world) and the parent firm's total sales (domestic sales in Japan and exports). The vertical line indicates Brexit in 2016. Source: Authors' compilation based on BSOBA, BSJBSA, and METI, Japan.

The foreign business environment differs substantially from Japan's domestic business environment. To exclude domestic factors in Japan, in Figure 2, we plot the shares of affiliates' sales in the UK and the EU in the total *overseas* sales of Japanese MNEs from 2010 to 2019. The sales of affiliates in the UK accounted for approximately 4% of MNEs' total overseas sales in 2015, and this share dropped significantly from 2016. In contrast, sales of affiliates in the EU accounted for less than 10% of MNEs' total overseas sales in 2015 but increased significantly in 2016 and afterwards.

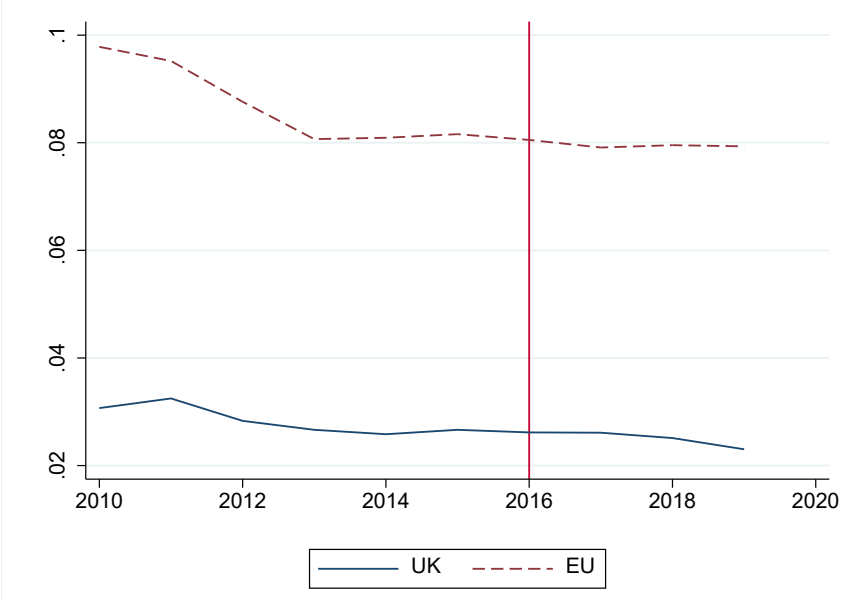
Figure 3 shows the shares of the number of affiliates in the UK and EU of the total number of Japanese foreign affiliates. Both shares declined before 2013 but remained steady until 2016. In 2016, the UK's share was approximately 3% and the EU's share was 8%. The UK's share declined slightly from 2018 to 2019. Although the number of affiliates in the UK is limited, they account for a non-negligible share of sales' total overseas sales.

Figure 2. UK and EU's shares in Japanese MNEs' overseas sales



Note: This figure shows the shares of affiliates' sales in the UK and the EU in the total overseas sales of Japanese MNEs. The overseas sales of MNEs are the total sales of all foreign affiliates worldwide. The vertical line indicates Brexit in 2016. Source: Authors' compilation based on BSOBA, METI, Japan.

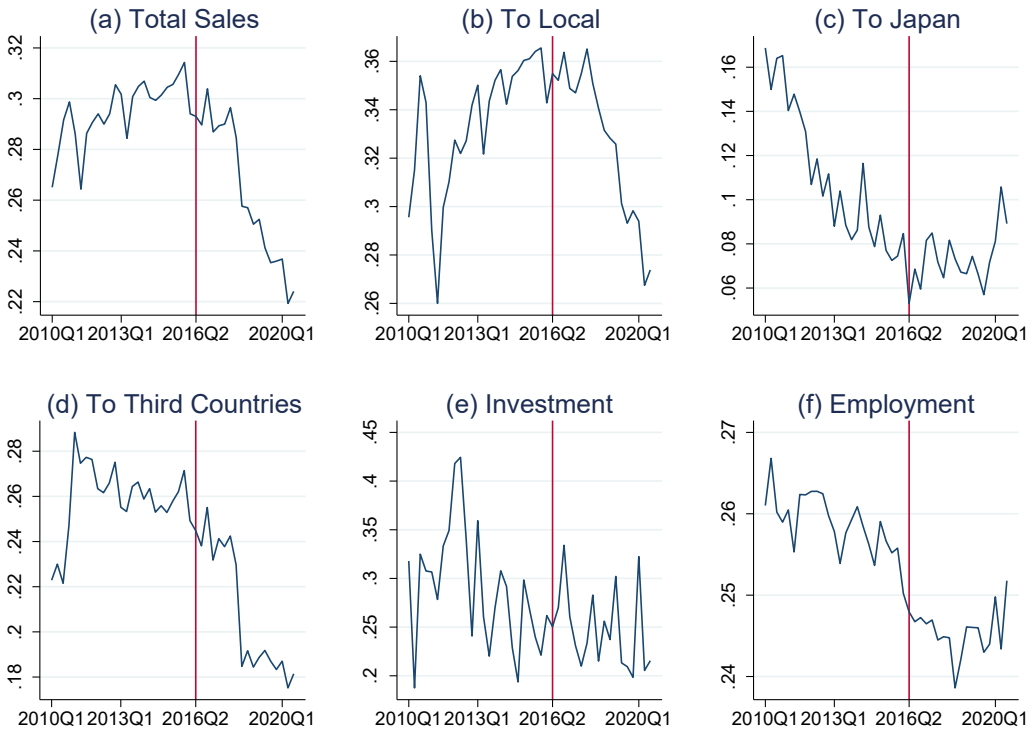
Figure 3. UK and EU's shares in the number of Japanese affiliates



Note: This figure shows the share of the number of affiliates in the UK and EU of the total number of Japanese foreign affiliates. The vertical line indicates Brexit in 2016. Source: Authors' compilation based on BSOBA, METI, Japan.

Next, using quarterly data on foreign manufacturing affiliates, we present the relative importance of the UK as a production base in Europe for Japanese MNEs. For sales (and its decomposition), investment, and employment, we calculate the shares of the UK in Europe (the sum of the UK and EU members). The UK accounted for approximately 30% of total sales before Brexit, but this share declined significantly to 22% in 2019. Local sales and exports to Japan and third countries show different patterns. The UK's share in local sales increased to more than 30% before Brexit but dropped significantly after 2016. Surprisingly, the UK exports to Japan and other countries began to collapse before 2016. For exports to Japan, the UK's share remained steady after 2016 (except during the Covid-19 period); however, for exports to third countries, the UK's share continued to decline to approximately 18% in 2020. The UK's investment share was high before 2013 but became relatively lower after that. However, a substantial decline in employment in the UK was observed after Q2 2016. These results suggest that the UK's role as a production base and export platform weakened, particularly after Brexit in 2016.

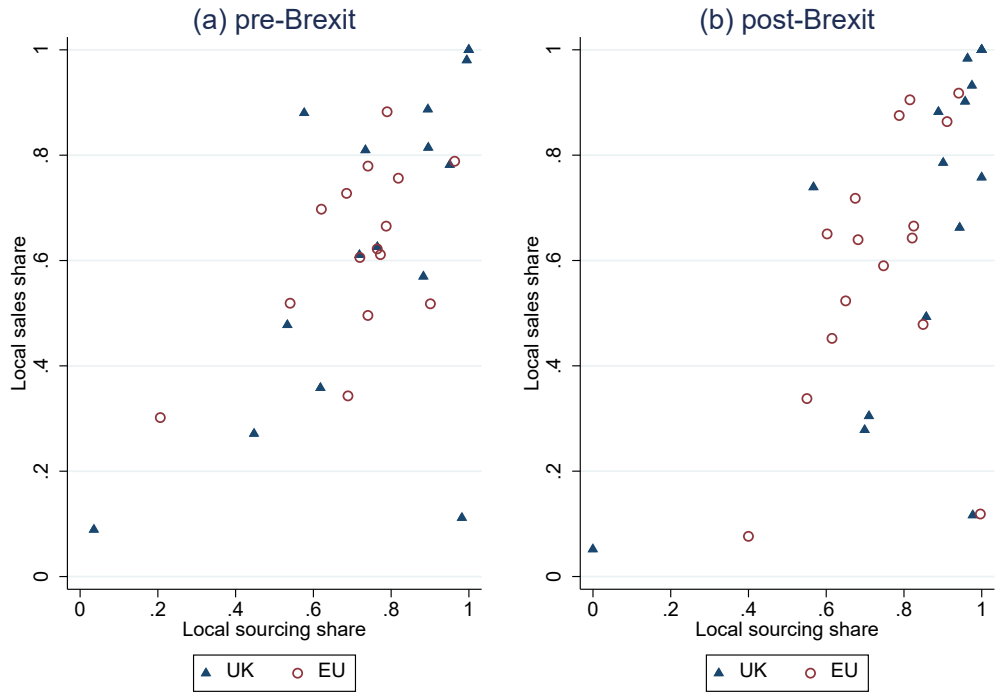
Figure 4. UK's presence as a production base in Europe



Note: This figure shows the UK's share in Europe (UK and EU members) in terms of foreign affiliates' sales, investment, and employment in the manufacturing sector. The vertical line indicates Brexit in Q2, 2016. Source: Authors' compilation based on the QSOS, METI, Japan.

We then explore the sourcing and sales patterns of Japanese foreign affiliates, with a focus on the UK and the EU before and after Brexit in 2016. We use the "sales-sourcing box" to illustrate whether and how Japanese affiliates' trade patterns changed in the UK. Specifically, we aggregate all affiliates in the UK and EU by industry according to the share of its output sold locally as well as by the shares of its intermediate purchases acquired locally.

Figure 5. Sales-sourcing patterns of Japanese affiliates before and after Brexit: Manufacturing



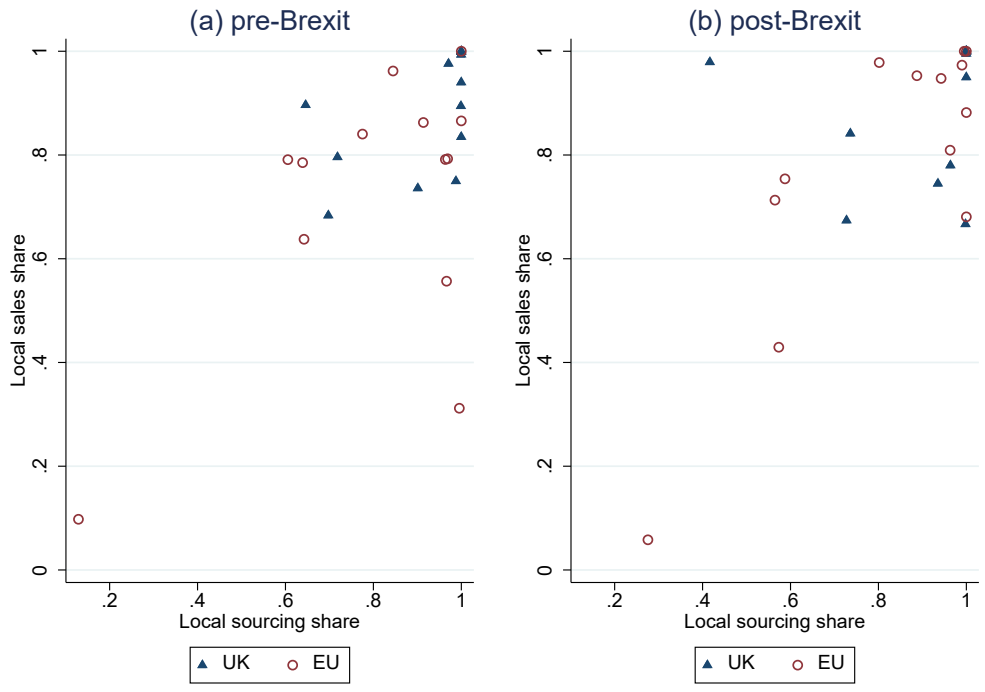
Note: This figure shows the sales-sourcing patterns of manufacturing affiliates in the UK and the EU before and after Brexit. Pre-Brexit is the period between 2010 and 2015 and post-Brexit is the period between 2016 and 2019. Source: Authors' compilation based on BSOBA, METI, Japan.

In Figure 5, each industry is plotted as a triangle for the UK and as a dot for the EU before Brexit (left panel) and after Brexit (right panel). The horizontal axis represents the share of intermediates sourced locally, and the vertical axis represents the share of output sold locally.[17] The affiliates

[17] Using the sales-sourcing box diagram, Baldwin and Okubo (2014) argue that (i) the northeast corner is pure horizontal FDI (affiliates source all intermediates locally and sell all output locally), (ii) the western border is pure vertical FDI (all intermediates are sourced from abroad but some of the final goods output is exported back to the home country), (iii) the northwest is local assembly FDI (all intermediates are imported and all output is sold locally, (iv) the southwest corner is pure export-

marked by intermediate levels of local sales and sourcing are networked FDI and are more integrated into international supply chains. Both panels show that manufacturing FDI in both regions is mixed, with networked and horizontal FDI (affiliates source most of the intermediates locally and sell most of the output locally). However, in the post-Brexit period, manufacturing industries in the UK tended to be more concentrated in the northeast corner, implying an increasing horizontalness of the affiliates. In other words, the substitutability of FDI and trade of affiliates in the UK increased after Brexit. In the UK, more industries have local sourcing shares of over 60% and sales shares of over 60%. Compared to the UK, the EU tends to have more networked FDI after Brexit. This suggests that Japanese MNEs still view the EU (excluding the UK) as a single market and tend to hold a production base in a limited number of EU countries (excluding the UK), exporting them to other EU members.

Figure 6. Sales-sourcing patterns of Japanese affiliates before and after Brexit: Non-manufacturing



Note: This figure shows the sales-sourcing patterns of non-manufacturing affiliates in the UK and EU before and after Brexit. Pre-Brexit isthe period between 2010 and 2015 and post-Brexit is the period between 2016 and 2019. Source: Authors' compilation based on BSOBA, METI, Japan.

platform FDI (all intermediates are imported and all output is exported), and (v) the southeast corner is resource extraction FDI (all intermediates are sourced locally and all output is exported).

Similarly, Figure 6 shows the outsourcing and sales patterns of Japanese non-manufacturing affiliates in the UK and EU before and after Brexit in 2016. In both panels, the sales-sourcing patterns of non-manufacturing industries are close to horizontal FDI. Most rely almost entirely on local intermediates and sell virtually all their outputs locally. For non-manufacturing affiliates in the UK, their sales-sourcing patterns did not change substantially in the post-Brexit period, suggesting the nature of horizontalness in service FDI and lower substitutability in service trade relative to trade in goods.

4. Empirical analysis

4.1 Empirical specifications

This study examined the impact of the 2016 Brexit referendum on Japanese affiliates in the UK. To this end, we conduct a difference-in-differences (DID) analysis. The baseline empirical specification is as follows:

$$Y_{ict} = \alpha_0 + \alpha_1 UK_{ic} \times Post_t + FE_i + FE_p + FE_{st} + \varepsilon_{it} \quad (1)$$

where Y_{ict} is the outcome variable of foreign affiliate i in country c and year t. The outcome variables include (i) sales-sourcing patterns (sales, sourcing, and their decompositions: to or from local, Japan, third countries, and Europe), (ii) firm behaviors (capital investment, number of employees, number of Japanese expats, entry, and exit), and (ii) other firm performance (labor productivity and profitability). UK_i is a dummy variable that equals 1 if affiliate i of a Japanese MNEs is located in the UK; otherwise, it is 0. $Post_t$ equals 0 before 2016, 0.75 in 2016, and it takes the value of 1 in 2017 and subsequent years. $Post_t$ was set to 0.75 in 2016, because our data are in the fiscal year (i.e., from April to March in Japan), and the Brexit referendum was held on June 23, 2016.[18] The coefficient of interest is α_1 and we expect α_1 be negative, implying that Brexit negatively affects foreign affiliates in the UK. We control for affiliate fixed effects FE_i, headquarters (parent) fixed effects FE_p, and industry-year fixed effects FE_{st}. We cluster standard errors at the country level.

We want to examine not only the average effect of all years after the shock but also the persistence of the effect. To investigate the dynamic effect of Brexit, we estimate an extended version of Equation (1) by allowing Brexit to have a flexible effect on the outcome variables. Specifically,

[18] The estimated results of taking 1 in 2016 are robust and quantitatively similar.

we consider a full set of interactions between the UK dummy and the time dummies over our sample period and estimate the following equation:

$$Y_{it} = \alpha_0 + \sum_{t=2010}^{2019} \alpha_t UK_{ic} \times Post_t + FE_i + FE_p + FE_{st} + \varepsilon_{it} \quad (2)$$

We are particularly interested in the treatment effect every year after Brexit, i.e., α_t, t = 2016, 2017, 2018, 2019.

In our baseline estimations, we rely on samples of foreign affiliates in the UK (treatment group) and the EU (control group). We use affiliates in the EU as the control group for two reasons. (1) The UK and EU were in a single market before Brexit, sharing the same trade policy and business environment for Japanese MNEs. (2) As shown in Tables 1-2, relative to the full sample, the UK and EU samples are more similar, especially in terms of sales-sourcing patterns, indicating good comparability between the two groups.

For robustness checks, we also considered alternative samples as treatment and control groups. First, we used Japanese affiliates in the UK as the treatment group and those in all non-UK host countries as the control group. The results of the robustness checks are reported in the Appendix.

4.2 Results

In this subsection, we present the baseline estimation results of Equation (1) and plot the treatment effect in the time series (estimated coefficients of Equation (2)) for sales-sourcing patterns, firm behaviors, and other firm performances. Then, we report the estimation results using quarterly firm-level data.

4.2.1 Sales-sourcing patterns

Table 3 reports the estimation results on the impact of Brexit on the sales patterns of Japanese affiliates in the UK. Panel A, B, and C report the results for all industries, manufacturing, and non-manufacturing industries, respectively. In Panel A, the estimated coefficients of $UK_{ic} \times Post_t$ are negative and statistically significant in all columns. We find that the Brexit referendum in 2016 significantly decreased the total sales of Japanese affiliates in the UK by approximately 11.1%, relative to Japanese affiliates in the EU. Their sales drop almost everywhere, mostly due to lower local sales in the UK, exports to Japan, and exports to the European market. Panels B and C show that, compared with manufacturing industries, the

negative effect on total sales is larger for non-manufacturing industries. When looking at the sales decomposition, exports to Japan and Europe significantly declined after Brexit in the manufacturing industries, suggesting the large negative impact of Brexit on export-oriented affiliates serving the EU's single market. In contrast, in the non-manufacturing industries, the largest decline was local sales, suggesting the negative demand/supply shocks for services after Brexit in the UK. Table A1 uses an alternative control group (Japanese affiliates in all non-UK countries) and most of the results remain robust. The exception is that relative to affiliates in all non-UK countries, affiliates in the UK still have larger exports to the European market after Brexit, suggesting that gravity still matters for exporting to European countries.

Table 3. Impact of Brexit on sales patterns

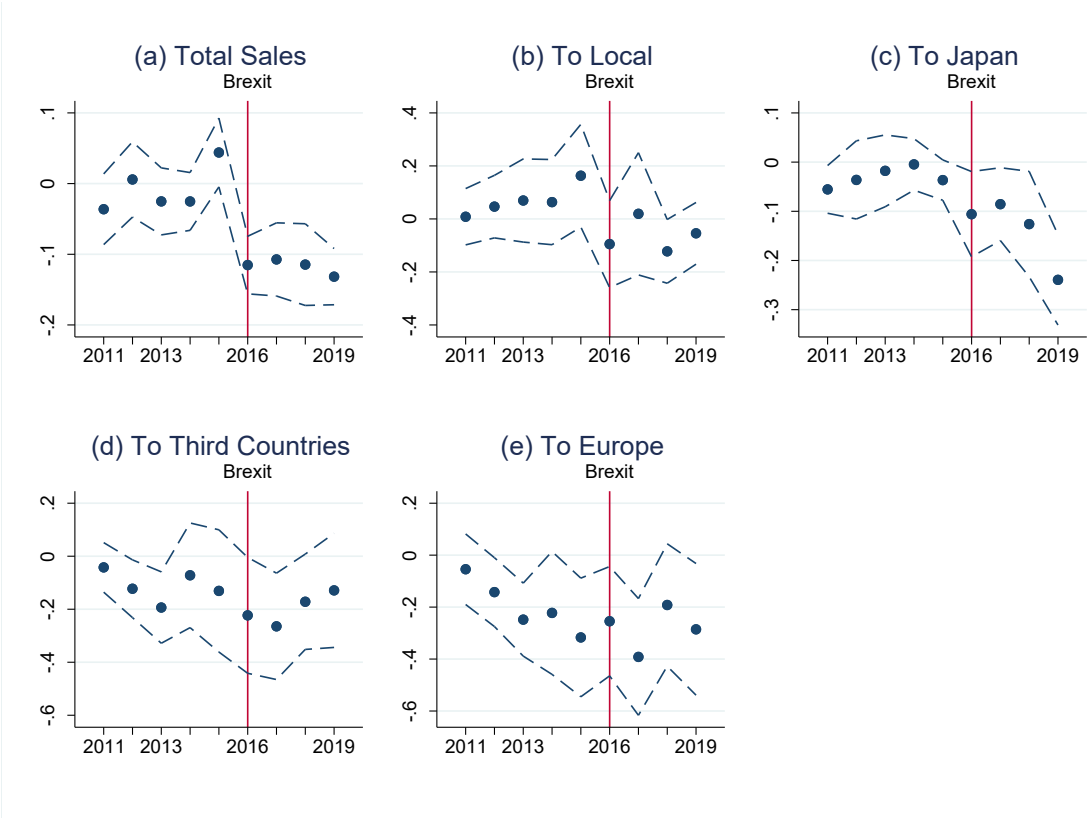
		(2)	(3)	(4)	(5)
Sample / Dependent Var:	Total Sales	To Local	To Japan	To Third Countries	To Europe
Panel A: All industries					
UK*post	-0.111***	-0.141***	-0.161***	-0.0903*	-0.105**
	(0.0213)	(0.0263)	(0.0334)	(0.0446)	(0.0404)
N	18774	18774	18774	18774	18774
R-sq	0.930	0.814	0.781	0.815	0.760
Panel B: Manufacturing					
UK*post	-0.0827**	-0.0225	-0.234***	-0.0770	-0.242**
	(0.0376)	(0.111)	(0.0657)	(0.113)	(0.116)
N	6109	6109	6109	6109	6109
R-sq	0.939	0.778	0.784	0.816	0.746
Panel C: Non-manufacturing					
UK*post	-0.117***	-0.206***	-0.113***	-0.0576*	-0.00172
	(0.0226)	(0.0351)	(0.0368)	(0.0305)	(0.0365)
N	12629	12629	12629	12629	12629
R-sq	0.924	0.830	0.776	0.805	0.755

Note: The sample covers foreign affiliates in the UK and the EU only. The sample period is between 2010 and 2019. A full set of fixed effects (affiliate, parent, and industry-year) is included in all the estimations. Standard errors are clustered at the country level. Significance level: * 0.10 ** 0.05 *** 0.01.

Figure 7 shows the differences in sales patterns between Japanese affiliates in the UK and those in the EU over time by plotting a set of estimated coefficients from the regression of sales (and

its decomposition) on $\alpha_t UK_{ic} \times Post_t$ along with a full set of fixed effects. For total sales, local sales, and exports to Japan, the two groups are balanced in terms of parallel trends, indicating good comparability between Japanese affiliates in the UK and affiliates in the EU. However, in the post-Brexit period, Japanese affiliates in the UK experienced sharp and persistent decreases in total sales, local sales, and exports to Japan compared with Japanese affiliates in the EU, indicating that Brexit had a large negative impact on the former group. Interestingly, exports to third countries, including Europe, show quite a different pattern: Japanese affiliates in the UK saw gradual declines in exports to these markets even before the Brexit referendum in 2016, and the negative effect after Brexit was somewhat short-lived. As Europe accounts for approximately 73% of the UK's total exports to third countries (Table 1), the time trends of exports to third countries and Europe are similar. This result suggests a negative impact of Brexit anticipation and uncertainty over the UK-EU trade policy on exports to the EU market.

Figure 7. Impact of Brexit on sales patterns: UK-year estimates, all industries



Note: This figure plots the estimates of the UK-year dummy variables for the period between 2011 and 2019, controlling for a full set of affiliate, parent, and industry-year fixed effects. Dotted lines represent the 95% confidence intervals.

Table 4. Impact of Brexit on sourcing patterns

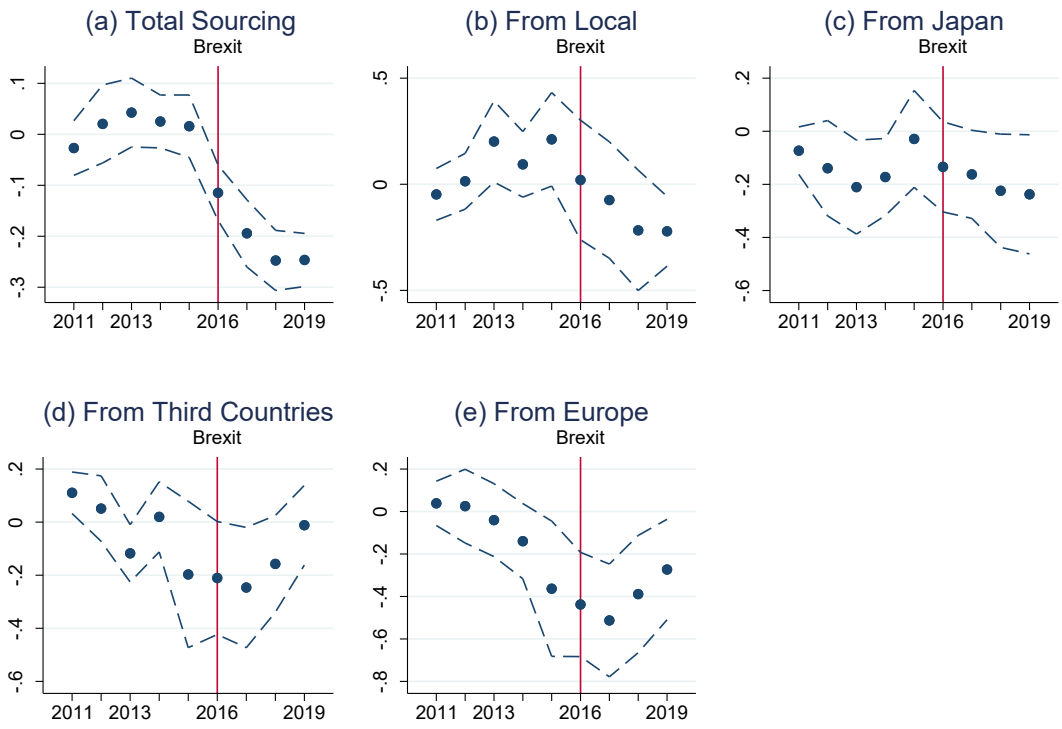
	(1)	(2)	(3)	(4)	(5)
Sample / Dependent Var:	Total Sourcing	From Local	From Japan	From Third Countries	From Europe
Panel A: All industries					
UK*post	-0.142***	-0.190***	-0.0665	-0.111**	-0.304***
	(0.0252)	(0.0630)	(0.0438)	(0.0520)	(0.0778)
N	17705	17705	17705	17705	17705
R-sq	0.917	0.802	0.855	0.808	0.749
Panel B: Manufacturing					
UK*post	-0.118***	-0.308***	-0.167*	0.163*	-0.0934
	(0.0362)	(0.0917)	(0.0856)	(0.0881)	(0.100)
N	5860	5860	5860	5860	5860
R-sq	0.917	0.769	0.817	0.789	0.726
Panel C: Non-manufacturing					
UK*post	-0.152***	-0.143	-0.0186	-0.238**	-0.398***
	(0.0335)	(0.104)	(0.0696)	(0.0907)	(0.130)
N	11813	11813	11813	11813	11813
R-sq	0.916	0.793	0.873	0.819	0.761

Note: The sample covers foreign affiliates in the UK and EU only. The sample period is between 2010 and 2019. A full set of fixed effects (affiliate, parent, and industry-year) is included in all the estimations. Standard errors are clustered at the country level. Significance level: * 0.10 ** 0.05 *** 0.01.

Table 4 presents the estimation results of the impact of Brexit on the sourcing patterns of Japanese affiliates in the UK. In Panel A, the estimated coefficients of $UK_{ic} \times Post_t$ are negative and statistically significant in all columns except Column (3). The Brexit referendum significantly decreased the total sourcing of Japanese affiliates in the UK by approximately 14.2%, relative to Japanese affiliates in the EU. Their purchases dropped almost everywhere, mostly because of lower local sourcing and imports from the European market. Panels B and C show that the negative effect on total sourcing is larger for non-manufacturing industries than for manufacturing industries. Specifically, the total sourcing declined by 11.8% in the manufacturing industry and 15.2% in the non-manufacturing industry. Regarding sourcing decomposition, local purchases and imports from Japan in the manufacturing industry declined significantly after Brexit. Simultaneously, imports from third countries increased, except in Europe, suggesting the possibility of trade diversion from the EU to other third countries. In contrast, imports from

Europe and third countries dropped significantly in non-manufacturing industries, suggesting a higher trade cost in service trade than in goods trade. Our results remain robust (with even larger estimates) when we use the alternative control group (Japanese affiliates in all non-UK countries; see Table A2 in the Appendix).

Figure 8. Impact of Brexit on sourcing patterns: UK-year estimates, all industries



Notes: This figure plots the estimates of the UK-year dummy variables for the period between 2011 and 2019, controlling for a full set of affiliate, parent, and industry-year fixed effects. Dotted lines represent the 95% confidence intervals.

Figure 8 shows the differences in sourcing patterns between Japanese affiliates in the UK and those in the EU over time. Regarding total sourcing, local sourcing, and imports from Japan, the two groups are balanced in terms of parallel trends (imports from Japan are volatile), indicating good comparability between Japanese affiliates in the UK and affiliates in the EU. However, in the post-Brexit period, Japanese affiliates in the UK experienced sharp and persistent decreases in total sourcing, local sourcing, and imports from Japan compared with Japanese affiliates in the EU. Similar to sales patterns, imports from third countries, including Europe, show quite a different pattern: Japanese affiliates in the UK saw gradual declines in imports from these markets

even before the Brexit referendum in 2016, and the negative effect was short-lived after 2016. As Europe accounts for approximately 46% of the UK's total sourcing from third countries (Table 1), the time trends of imports from third countries and Europe are similar. Similar to the sales patterns, this result suggests the negative anticipation effect of Brexit and the negative trade effect of policy uncertainty on imports from the EU.

4.2.2 Firm behaviors

In addition to sales-sourcing patterns, Brexit may significantly affect firm behavior. Table 5 reports the results of firms' responses to Brexit. First, regarding firm investment, compared with Japanese affiliates in the EU, affiliates in the UK experienced a decline in investment (log) by approximately 5.9%, but not in investment decisions (0,1), suggesting that investment declined through the intensive margin and not the extensive margin. Manufacturing firms accounted for the decline in capital investments. Second, the numbers of employees and Japanese expats in the UK decreased by approximately 9.4% and 3%, respectively, after Brexit. Manufacturing firms adjusted their employment more than non-manufacturing firms. Third, the probability of exit, that is, divestment (dissolution, withdrawal, or decline in control share), increased significantly by approximately 1.1% points after Brexit. Given that the mean exit probability was 3.3% in the full sample (see Table 1), a 1.1% points increase was large. Compared to manufacturing industries, the probability of exit is high in non-manufacturing industries. Surprisingly, however, the probability of Japanese manufacturing affiliates entering the UK was high after Brexit, suggesting a possible increase in horizontal FDI in the UK.

As a robustness check, Table A3 presents an alternative control group (Japanese affiliates in all non-United Kingdom countries). Brexit has a negative impact on investment and employment (number of employees) in non-manufacturing industries. Consistent with our baseline results, relative to affiliates in all non-UK countries, affiliates in the UK still have a higher probability of entry into manufacturing industries but a higher probability of exit in non-manufacturing industries, suggesting heterogeneous responses across industries.

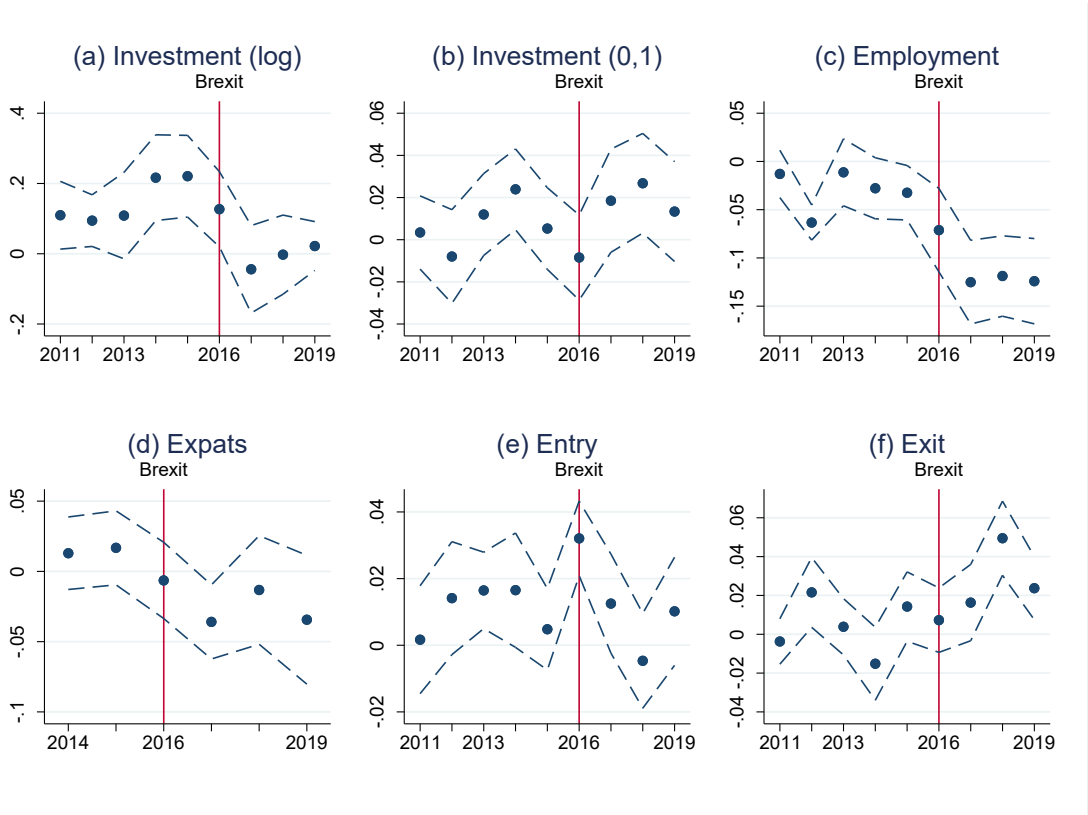
Table 5. Impact of Brexit on firm behaviors

	(1)	(2)	(3)	(4)	(5)	(6)
Sample / Dependent Var:	Investment (log)	Investment (0,1)	Employment	Expats	Entry	Exit
Panel A: All industries						
UK*post	-0.0586*	0.00202	-0.0937***	-0.0295**	0.00646*	0.0109**
	(0.0331)	(0.00718)	(0.0249)	(0.0110)	(0.00319)	(0.00481)
N	10199	26750	21314	14908	26750	26750
R-sq	0.797	0.647	0.942	0.846	0.167	0.172
Panel B: Manufacturing						
UK*post	-0.160***	-0.0104	-0.109*	-0.0773***	0.0210***	0.00281
	(0.0496)	(0.0130)	(0.0538)	(0.0196)	(0.00578)	(0.00419)
N	4469	7901	6627	4598	7901	7901
R-sq	0.787	0.635	0.920	0.833	0.207	0.152
Panel C: Non-manufacturing						
UK*post	0.0218	0.00604	-0.0856**	-0.00919	0.000552	0.0137**
	(0.0610)	(0.00915)	(0.0328)	(0.0165)	(0.00365)	(0.00574)
N	5709	18789	14644	10272	18789	18789
R-sq	0.741	0.622	0.937	0.849	0.154	0.178

Note: The sample covers foreign affiliates in the UK and EU only. The sample period is between 2010 and 2019, with the exception of expats (2013-2019). A full set of fixed effects (affiliate, parent, and industry-year) is included in all the estimations. Standard errors are clustered at the country level. Significance level: * 0.10 ** 0.05 *** 0.01.

Figure 9 presents the differences in firm behavior and performance between Japanese affiliates in the UK and those in the EU over time. As for investment, the differences and time trends between the two groups were not clear in the pre-Brexit period. Investment dropped in 2016 but increased thereafter, probably because of a weaker pound. In contrast, for employment, productivity, profitability, and exit rate, the two groups are balanced in terms of parallel trends, indicating good comparability between Japanese affiliates in the UK and affiliates in the EU. However, in the post-Brexit period, Japanese affiliates in the UK experienced sharp and persistent decreases in employment (excluding Japanese expats), productivity, and profitability compared with Japanese affiliates in the EU. This has led to a significant increase in the probability of Japanese affiliates withdrawing and divesting from the UK market.

Figure 9. Impact of Brexit on firm behavior: UK-year estimates, all industries



Note: This figure plots the estimates of UK-year dummy variables for the period between 2011 and 2019, except for expats (2013-2019), controlling for a full set of affiliate, parent, and industry-year fixed effects. Dotted lines represent the 95% confidence intervals.

4.2.3 Other firm performance

We then examine the impact of Brexit on other firms' performance: productivity and profitability. The results are summarized in Table 6. As Panel A indicates, compared with Japanese affiliates in the EU, on average, affiliates in the UK experienced a decline in labor productivity by approximately 7.1% and profitability by 1.8% after Brexit. Declines in productivity and profitability are observed in both manufacturing and non-manufacturing industries. As shown in Panel B, our baseline results remained robust when using an alternative control group. The larger estimates imply that compared with Japanese affiliates in all non-UK countries, affiliates in the UK experienced even larger declines in productivity and profitability.

Figure 10 shows the differences in labor productivity (panel a) and profitability (panel b) between Japanese affiliates in the UK and affiliates in the EU over time. Japanese affiliates in the UK had higher productivity before Brexit, but experienced sharp and persistent decreases in productivity

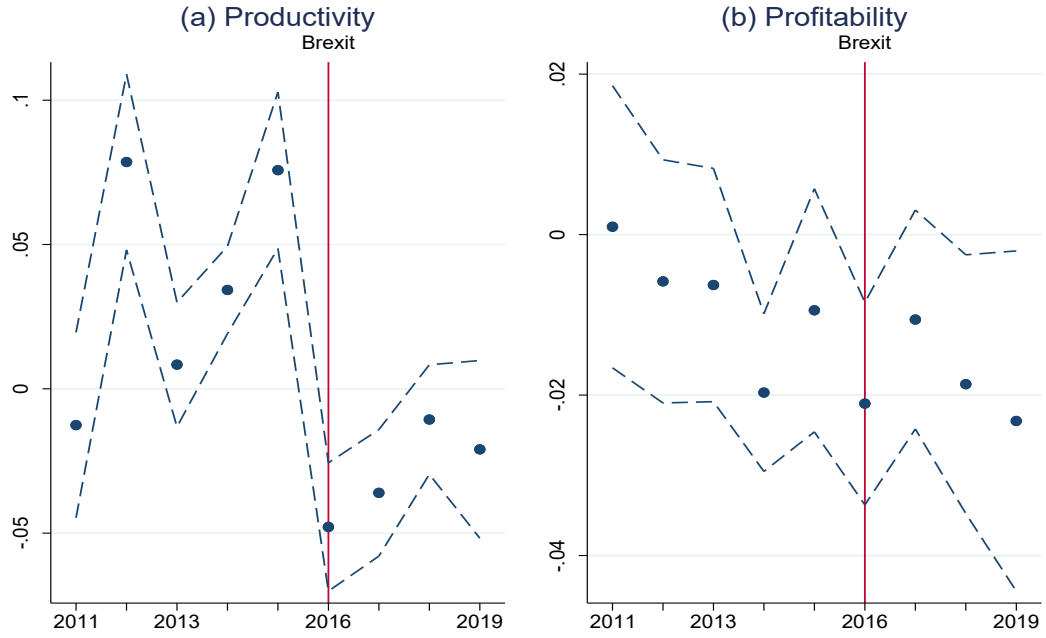
after Brexit. On the other hand, profitability shows quite a different pattern: Japanese affiliates in the UK saw a gradual decline in profitability, even before Brexit.

Table 6. Impact of Brexit on firm performance

	(1)	(2)	(3)	(4)	(5)	(6)
Sample / Dependent Var:	Productivity	Profitability	Productivity	Profitability	Productivity	Profitability
	All industries		Manufacturing		Non-manufacturing	
Panel A: UK & EU						
UK*post	-0.0711***	-0.0175***	-0.0256	-0.0170**	-0.0867***	-0.0174***
	(0.0120)	(0.00444)	(0.0234)	(0.00785)	(0.0129)	(0.00561)
N	17398	18222	5952	6051	11415	12136
R-sq	0.880	0.487	0.857	0.519	0.877	0.470
Panel B: All countries						
UK*post	-0.179***	-0.0248***	-0.169***	-0.0335***	-0.168***	-0.0213***
	(0.0421)	(0.00525)	(0.0434)	(0.00585)	(0.0435)	(0.00646)
N	173984	184594	83663	86160	90066	98163
R-sq	0.894	0.418	0.887	0.418	0.881	0.421

Note: The sample coverage includes foreign affiliates in the UK and EU in Panel A and in all host countries in Panel B. The sample period is between 2010 and 2019. A full set of fixed effects (affiliate, parent, and industry-year) is included in all the estimations. Standard errors are clustered at the country level. Significance level: * 0.10 ** 0.05 *** 0.01.

Figure 10. Impact of Brexit on firm performance: UK-year estimates, all industries



Note: This figure plots the estimates of the UK-year dummy variables for the period between 2011 and 2019, controlling for a full set of affiliate, parent, and industry-year fixed effects. Dotted lines represent the 95% confidence intervals.

4.2.4 Sales patterns and firm behaviors: Quarterly data

As discussed previously, we also have quarterly information on sales (and their decomposition), investments, and employment for manufacturing affiliates. Quarterly data offer two advantages. First, we define the timing of Brexit (June 2016) at a quarterly level, which may have improved our identification. Second, it covers more manufacturing affiliates in UK and non-UK countries over a longer period. For additional analysis and robustness checks, we estimated Equations (1) and (2) using quarterly data. $Post_t$ equals zero before Q1 2016 and one in Q2 2016 and subsequent quarters.[19] Similar to the annual data, we use the UK and EU samples and the full sample separately in the estimations. As shown in Table 7 and Figures 11-12, the results are consistent with our results using annual data, particularly for the UK and European Union samples.

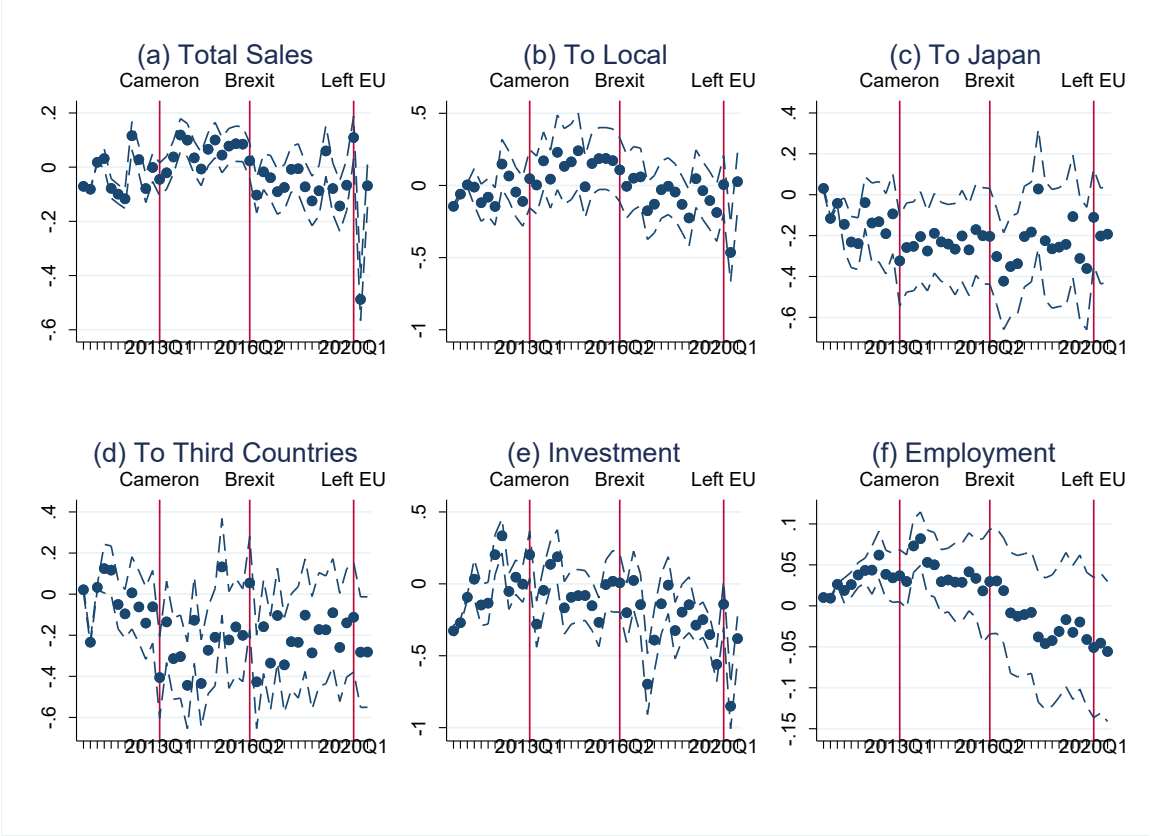
[19] Our results remain robust if $Post_t$ equals 1 in Q3 2016 and the subsequent quarters.

Table 7. Impact of Brexit on sales patterns and firm behaviors: Quarterly data

	(1)	(2)	(3)	(4)	(5)	(6)
Sample / Dependent Var:	Total Sales	To Local	To Japan	To Third Countries	Investment	Employment
Panel A: UK & EU						
UK*post	-0.0693**	-0.102	-0.0559	-0.0557	-0.183***	-0.0562*
	(0.0294)	(0.0597)	(0.0567)	(0.0631)	(0.0467)	(0.0279)
N	16200	16200	16200	16200	10617	16200
R-sq	0.947	0.902	0.842	0.876	0.669	0.971
Panel B: All countries						
UK*post	-0.0965***	-0.164***	-0.0932***	-0.101***	-0.0186	-0.00698
	(0.0201)	(0.0269)	(0.0207)	(0.0287)	(0.0598)	(0.0349)
N	190606	190606	190606	190606	114282	190606
R-sq	0.931	0.907	0.889	0.865	0.616	0.959

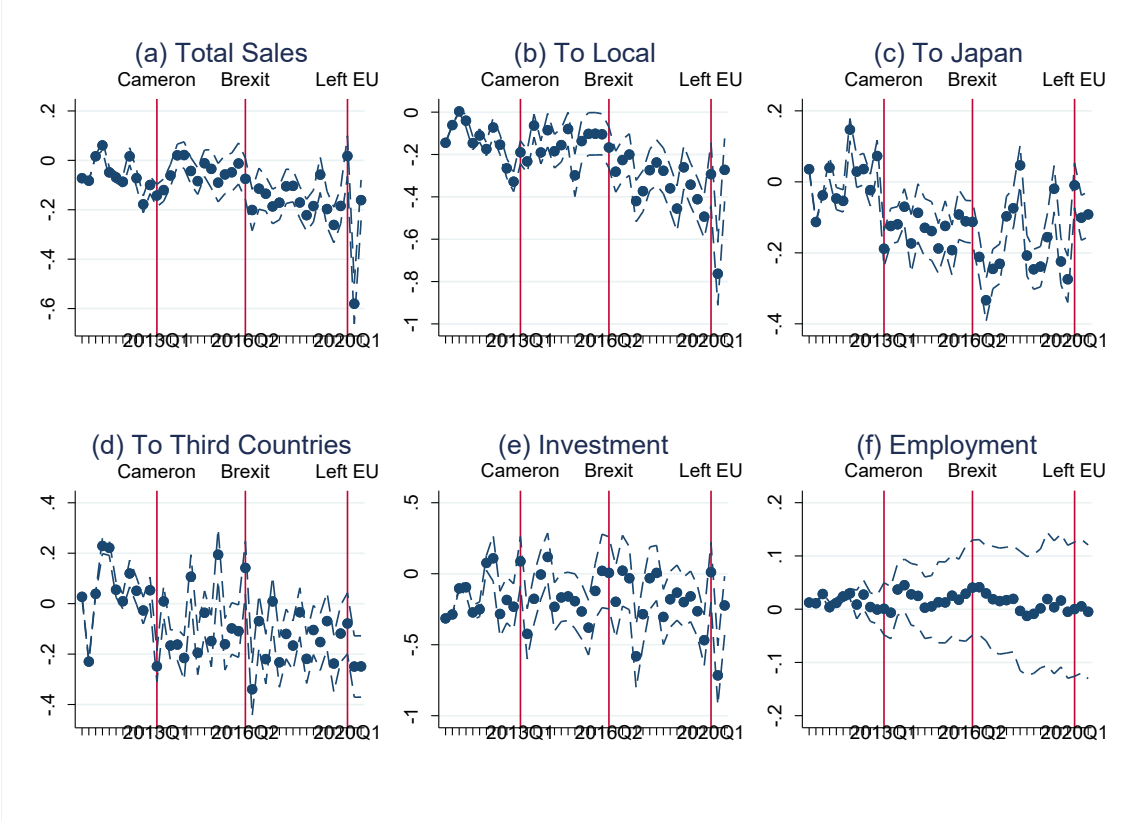
Note: The sample coverage includes foreign affiliates in all host countries in Panel A and foreign affiliates in the UK and EU only in Panel B. The sample period is from Q2 2010 to Q1 2020. A full set of fixed effects (affiliate, parent, country, and industry-year) is included in all estimations. Standard errors are clustered at the country level. Significance level: * 0.10 ** 0.05 *** 0.01.

Figure 11. Impact of Brexit on sales patterns and firm behaviors: UK-time estimates, quarterly, UK and EU samples



Note: This figure plots the estimates of the UK-time dummy variables for Q2 2010 to Q3 2020, controlling for a full set of affiliate, parent, and industry-year fixed effects. Dotted lines represent the 95% confidence intervals. On January 23, 2013, Prime Minister David Cameron promised a referendum on Britain's EU membershipbefore 2017. The Brexit referendum was held on June 23, 2016. On January 31, 2020, the UK left the EU and entered a transition period.

Figure 12. Impact of Brexit on sales patterns and firm behaviors: UK-time estimates, quarterly, full sample



Note: This figure plots the estimates of the UK-time dummy variables for Q2 2010 to Q3 2020, controlling for a full set of affiliate, parent, and industry-year fixed effects. Dotted lines represent the 95% confidence intervals. On January 23, 2013, Prime Minister David Cameron promised a referendum on Britain's EU membership before 2017. The Brexit referendum was held on June 23, 2016. On January 31, 2020, the UK left the EU and entered a transition period.

5. Conclusion

We use rich firm-level data on Japanese foreign affiliates over the period 2010-2019 to examine the impact of the 2016 Brexit referendum on multinational production and global supply chains. First, the Brexit referendum generated a significant negative shock for Japanese affiliates in the UK. We find that, relative to Japanese affiliates in the EU, the sales and purchases of Japanese affiliates in the UK were negatively affected, especially local sales and purchases, exports to, and imports from the European market. The employment, productivity, and profitability of Japanese affiliates in the UK declined significantly after 2016, leading to a substantial increase in the probability of Japanese affiliates leaving the UK. Therefore, the impact of Brexit is beyond that of the UK and EU, which are directly involved. Trade and multinational production linkages

across countries must be considered to understand its impact on the global economy.

Although our research provides a rich description of how Brexit affects MNEs and multinational production, there are some caveats in interpreting the results. The annual data sample ended in 2019, although the quarterly data analysis lasted until Q3 2020. This means that we only analyzed the impact of the Brexit referendum in 2016, and it is difficult to analyze the impact after the UK formally left the EU in January 2020 and not possible to evaluate the EU-UK TCA in January 2021. Thus, our findings may only reflect the impact of Brexit-associated uncertainty shocks and firm expectations rather than real changes in trade policy, trade costs, and political regimes. We intend to identify the impact of uncertainty shocks and firm expectations and expand our analysis as more data become available.

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Appendix: Robustness checks

Table A1. Impact of Brexit on sales patterns: Full sample

	(1)	(2)	(3)	(4)	(5)
Sample / Dependent Var:	Total Sales	To Local	To Japan	To Third Countries	To Europe
Panel A: All industries					
UK*post	-0.218***	-0.370***	-0.0848***	-0.0359*	0.0813***
	(0.0355)	(0.0410)	(0.0200)	(0.0185)	(0.0149)
N	188472	188472	188472	188472	188472
R-sq	0.920	0.835	0.807	0.798	0.779
Panel B: Manufacturing					
UK*post	-0.154***	-0.377***	-0.130***	0.0944**	0.103***
	(0.0313)	(0.0464)	(0.0420)	(0.0388)	(0.0288)
N	87128	87128	87128	87128	87128
R-sq	0.922	0.843	0.822	0.793	0.785
Panel C: Non-manufacturing					
UK*post	-0.240***	-0.353***	-0.0675***	-0.0872***	0.0702***
	(0.0414)	(0.0434)	(0.0180)	(0.0250)	(0.0117)
N	101068	101068	101068	101068	101068
R-sq	0.915	0.826	0.774	0.796	0.773

Note: The sample covers foreign affiliates in all host countries. The sample period is between 2010 and 2019. A full set of fixed effects (affiliate, parent, and industry-year) is included in all the estimations. Standard errors are clustered at the country level. Significance level: * 0.10 ** 0.05 *** 0.01.

Table A2. Impact of Brexit on sourcing patterns: Full sample

	(1)	(2)	(3)	(4)	(5)
Sample / Dependent Var:	Total Sourcing	From Local	From Japan	From Third Countries	From Europe
Panel A: All industries					
UK*post	-0.259***	-0.286***	-0.178***	-0.122***	-0.171***
	(0.0383)	(0.0408)	(0.0314)	(0.0166)	(0.00959)
N	181092	181092	181092	181092	181092
R-sq	0.907	0.811	0.816	0.771	0.733
Panel B: Manufacturing					
UK*post	-0.143***	-0.260***	-0.305***	-0.0617*	-0.116***
	(0.0262)	(0.0373)	(0.0304)	(0.0358)	(0.0179)
N	85871	85871	85871	85871	85871
R-sq	0.906	0.786	0.797	0.759	0.706
Panel C: Non-manufacturing					
UK*post	-0.310***	-0.324***	-0.114***	-0.140***	-0.190***
	(0.0496)	(0.0508)	(0.0376)	(0.0213)	(0.0160)
N	94953	94953	94953	94953	94953
R-sq	0.904	0.811	0.834	0.785	0.754

Notes: The sample covers foreign affiliates in all host countries. The sample period is between 2010 and 2019. A full set of fixed effects (affiliate, parent, and industry-year) is included in all the estimations. Standard errors are clustered at the country level. Significance level: * 0.10 ** 0.05 *** 0.01.

Table A3. Impact of Brexit on firm behaviors: Full sample

	(1)	(2)	(3)	(4)	(5)	(6)
Sample / Dependent Var:	Investment (log)	Investment (0,1)	Employment	Expats	Entry	Exit
Panel A: All industries						
UK*post	0.0272	0.00225	-0.0544	0.0135	0.00609	0.0177***
	(0.0408)	(0.00535)	(0.0382)	(0.0221)	(0.00518)	(0.00364)
N	94406	247449	205691	149293	247449	247449
R-sq	0.750	0.600	0.935	0.829	0.101	0.146
Panel B: Manufacturing						
UK*post	0.0494	0.0197**	0.0182	0.0275	0.00921**	0.00457
	(0.0532)	(0.00752)	(0.0588)	(0.0232)	(0.00365)	(0.00574)
N	58591	108068	91599	65976	108068	108068
R-sq	0.721	0.579	0.905	0.820	0.092	0.138
Panel C: Non-manufacturing						
UK*post	0.0000465	-0.00900*	-0.0839***	0.00969	0.00420	0.0229***
	(0.0379)	(0.00533)	(0.0300)	(0.0219)	(0.00612)	(0.00311)
N	35644	138991	113762	83060	138991	138991
R-sq	0.729	0.553	0.924	0.826	0.102	0.151

Notes: The sample covers foreign affiliates in all host countries. The sample period is between 2010 and 2019. A full set of fixed effects (affiliate, parent, country, and industry-year) is included in all estimations. Standard errors are clustered at the country level. Significance level: * 0.10 ** 0.05 *** 0.01.