The Heterogeneous Impact of Brexit: Early Indications from the FTSE

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Abstract

The UK's decision to leave the EU is surrounded by several studies simulating its potential effects. We take an alternative approach by examining how news of Brexit affected expectations as embodied in stock returns using a two-stage estimation process. While most firms had negative returns following news of the referendum's result, there was considerable heterogeneity in their changes relative to expectations. We show that this heterogeneity can be explained by the firm's global value chain, with heavily European firms doing worse. For firms with few imported intermediates, this was partially offset by a greater Sterling depreciation. These changes were primarily in the first two trading days and highly persistent. Understanding these movements gives a better understanding of Brexit's potential effects.

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1 Introduction

The UK's decision on 23 June 2016 to quit the European Union (EU) – "Brexit" – is undoubtedly one of the major events since the Great Recession of 2008. With implications spanning social, political, and economic concerns, there has been a flurry of activity attempting to predict what the consequences may be. In particular, given the potential for significant trade barrier increases, a number of studies have used computable general equilibrium analysis to develop predictions for various alterations to trade barriers.[1] For example, Dhingra et al. (2016a) predict that if trade barriers rise to those between the EU and Norway this will result in a 1.3% short-run loss to British income.[2] Alternatively, if protection levels rise to their World Trade Organization (WTO) most favored nation rates, their predicted losses are twice as large, with long-term losses running as high as 9.5%. While other simulation analyses obtain somewhat different predictions, the general expectation is that Brexit will have serious negative consequences for the UK and its major trading partners.[3] While such methods are one way of obtaining predictions for where the impacts of Brexit may be felt, we pursue an alternative which is based on the stock market reaction to the event.

Because investors base their current trading decisions on their expectations of the future performance of an asset, analyzing stock movements gives insight into how investors feel about the overall prospects of Brexit as well as how one firm is anticipated to fare relative to others. With this in mind, we use a two-stage estimation process similar to Blonigen, Tomlin, and Wilson (2004) which combines an event study methodology for firms listed on the FTSE 350 (the 350 largest firms on the London Stock Exchange) with a regression analysis. In the first stage, we estimate a firm's abnormal return following the Brexit referendum, that is, the average deviation from the actual return relative to its predicted return based on the performance of the overall market. We then regress this on firm characteristics measuring the firm's global value chain (GVC) structure (i.e where the firm's affiliates are located). This second stage indicates the extent to which a firm's performance relative to expectations depends on its relative GVC structure.

In particular, we focus on two main hypotheses. First, the greater the firm's GVC exposure to the UK and the EU, the greater the potential for Brexit to damage the firm's operations as Brexit creates barriers to the smooth operation of the GVC.[4] We find precisely this result with our estimates indicating that a 10% shift in the firm's affiliate share from outside Europe to the UK results in an abnormal return that is 20.8% smaller, i.e. it performs 20.8% below expectations based on the overall market's response to the Brexit vote. If that shift is instead to the EU (but not the UK), the firm does 19.1% worse relative to expectations. This indicates

[1] Sampson (2017) provides an overview of some of these as well as a discussion on various paths forward during the negotiation process.

[2] Norway has a free trade agreement with the EU but is not a member of the EU's customs union, so it faces the non-tariff barriers that apply to non-EU countries.

[3] Other studies in this vein, which cover various simulation exercises, include Head and Mayer (2015), PWC (2016), Fraser of Allander (2016) (who focus on Scotland), HM Treasury (2016), and OECD (2016). All of these find negative effects of various magnitudes whereas Minford, et al. (2016) find the potential for positive impacts on the UK. It should be noted that Sampson, et al. (2016) argue that Minford, et al.'s optimism is based on implausible assumptions on trade barrier changes and import elasticities.

[4] Head and Mayer (2015) describe three possible disadvantages of Brexit for foreign direct investment (FDI). First, an increase in trade barriers makes production in the UK less attractive because it becomes more costly to ship to the rest of Europe. Second, supplying inputs and staff from brands headquarters becomes more difficult (higher co-ordination costs). Third, UK products become less attractive to EU consumers after Brexit.

that investors are particularly bearish on firms with heavily European GVCs. Second, as the Sterling falls post-Brexit, this increases the firm's return from exporting while simultaneously increasing the cost of intermediate inputs, generating an ambiguous effect. Here, we find that on average these effects cancel out. That said, after controlling for the importance of imported intermediates, we find significant effects with one-third of firms doing worse compared to expectations when the Sterling fell relative to their key markets' currencies. As expected, this group is concentrated in those industries that are imported intermediates intensive. Beyond these main hypotheses, we also find that larger firms fared better whereas those with more affiliates (and potentially more complex GVCs) performed worse relative to expectations. This indicates that, even as the market as a whole fell, investors did not respond equally to all firms in the wake of Brexit and were particularly concerned with those whose GVCs are most vulnerable to increased trade barriers. Consistent with the growing body of literature demonstrating the productivity gains that come from being part of a GVC (e.g. Halpern, Koren, and Szeidl, 2015), one would expect a greater decline in the share price of such firms, which is indeed what we find.

Beyond this, we find that the market's reaction was sizable and remarkably swift. Following the announcement of the referendum's results in the evening of 23 June, the FTSE 350 lost 7% of its value over 24 and 27 June (the first two trading days following the result's announcement).[5] However, by a week later (June 30) it had reached its former level. Our analysis shows that, as with the decline, this recovery was not equal across firms. In particular, we find two things. First, the differential treatment in line with GVC differences was short-lived and confined to the first three trading days during which at-risk GVCs did markedly worse on the 24th and 27th but slightly better on 28 June. After that, however, the GVC variables no longer explain actual versus expected performance. Second, the cumulative abnormal return of such firms (the sum of the abnormal returns over a longer window) remained significantly lower. This means that, despite the slight rally for the most affected firms on 28 June, this was insufficient to offset their losses, with a net negative effect observable even four weeks after the referendum. Thus, while the market as a whole lost 7% of its value in those two days and then regained it over the next three, for firms with heavily European GVCs and small currency depreciations, the initial underperformance had a lasting effect.

In addition to the outcome of the referendum, we consider five subsequent Brexit related "events": 5 October 2016 (Brexit speech by Prime Minister May outlining her plan for negotiations), 3 November 2016 (referral of a case challenging the legality of Brexit to the Supreme Court), 17 January 2017 (the "Hard Brexit" speech by Prime Minister May), 24 January 2017 (the Supreme Court ruling that Parliament must be permitted to vote on Brexit), and 29 March 2017 (triggering of Article 50, commencing the two year negotiation period before Brexit). Unlike the aftermath of the referendum's outcome, the market reaction to these events was slight. This suggests that these subsequent events may have revealed little useful information. Further, we find little significance for our GVC variables in the determination of firms' abnormal returns. Thus by analyzing this set of quasi-placebo dates, we are able to provide further evidence that the market reaction – particularly for firms with at-risk GVCs – was largely manifested in the two trading days after the announcement of the referendum's results. This is further supported by using additional placebo events. Finally, we extend our analysis to the German HDAX index, where in comparison to the FTSE 350, firms' GVCs

[5]The market did not trade on Saturday 25 June or Sunday 26 June.

are fairly insulated from Brexit's implications due to their low UK presence and the fact that Brexit does not impact trade policy among remaining EU members. Here, although the market fell with a similar spike in abnormal returns after the Brexit vote, as expected the GVC variables have no explanatory power.

That the market's response was so swift and decisive may seem somewhat surprising. However, in preparation for their responses, many brokerage firms took steps to ensure that their traders were prepared to respond as soon as the markets were open, some going so far as to book hotels nearby so that traders could arrive at 2 am to prepare.[6] In addition, the firms that provide the technical framework for the operating of the major markets prepared by adding system capacity and halting upgrades in anticipation of the heavy volume.[7] Thus, it is clear that the markets were ready to respond when the results became clear. This anticipation, however, has the potential to cause concern for our event study since, if investors were altering their behavior prior to 24 June, this can muddy the waters when estimating the impact of the event. In our case, however, we do not feel that this is likely for two reasons. First, although the date of the referendum was known, its outcome was at best uncertain. Figure 1 shows the outcome of various polls for the year leading up to the referendum.[8] As can be seen, for the bulk of the period there was no clear dominance of the "remain" or "exit" camps. Only during the last few days of the campaign did one side dominate, with the remain voting leading. As an alternative metric for what was expected, one can look to the book-makers. On 23 June, betting agency Paddy Power had the odds for remain at 1/12 while the payoff for exit was 7/1, indicating that they (and other betting houses) expected the remain camp to prevail.[9] Thus, it seems fair to assume that the outcome of the referendum was a surprise. Second, if the market did indeed expect the referendum to fail, this would mean a continuation of the status quo, making it unlikely that there would be a significant change in average investor behavior prior to the vote. Indeed, as described in our data analysis below, we did not find a shift in abnormal returns until after the referendum's results were announced. Thus, the evidence suggests that markets were ready to move but did not do so until the results were announced, making the referendum a suitable event for study. Nevertheless, we perform robustness checks with an earlier estimation window, the results of which are comparable to our main findings.

Although the recent nature of the Brexit result means that there is currently little work on Brexit outside of the simulations discussed above, our analysis does tie into the extant literature in several ways. One part of the literature it fits into is that using event study analysis to investigate the impacts of trade policies. These studies generally examine the impact of sector-specific trade policies (often for the US) on the returns in the impacted industries. For example, Ries (1993) examines voluntary export restraints in the auto industry whereas Mahdavi and Bhagwati (1994) and Hughes, et al. (1997) consider protection against semiconductor imports. Steel is another oft-analyzed industry, with examples including Liebman and Tomlin (2007, 2008). Blonigen, Tomlin, and Wilson (2004) expand such analyses to multiple industries using the two-stage methodology we do. As one might expect, these studies find that protected firms tend to experience an abnormally positive return when protection from foreign competition occurs. In services, Davies, Liebman, and Tomlin (2015) examine

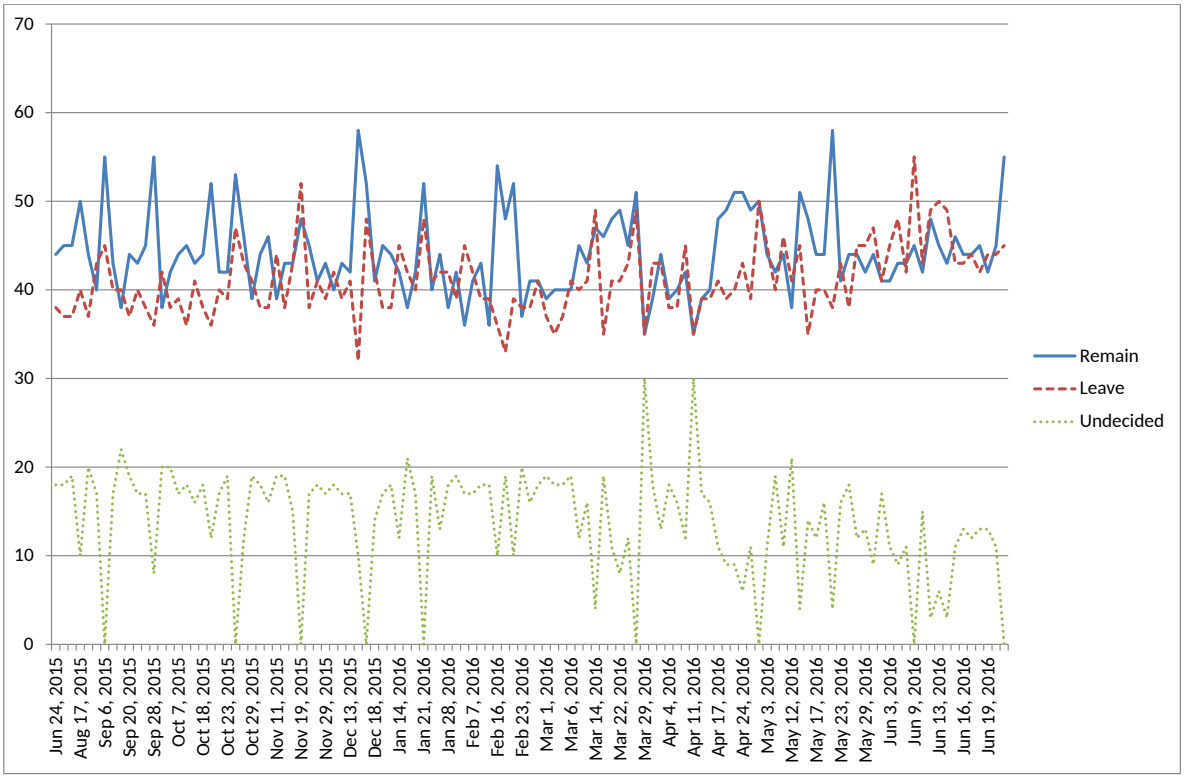
[6] See Irish Times (2017) for an entertaining discussion of the lengths brokerages were going to in order to be prepared as soon as markets opened.

[7] See Caves and Irrera (2016) for discussion.

[8] The data come from Financial Times (2016).

[9] See New Statesman (2016) for details.

Figure 1: Brexit polls



Source: Financial Times (2016).

the impact of the trucking industry provisions under NAFTA, finding that these effects differ between purely domestic trucking firms and those that operate both in the US and Mexico. Beyond these, two studies estimate the cross-sector impacts of US trade policy changes, with Desai and Hines (2004) looking at the effects of retaliation against the US's Foreign Sales Corporation regulations and Liebman and Tomlin (2015) who consider the impacts of changes in the application of US anti-dumping and countervailing duty policies.

Two event studies, however, are especially relevant to our discussion. The first is Schiereck, Kiesel, and Kolaric (2016) who compare abnormal returns for banks in the UK and in the EU following both Brexit and the Lehman Brothers bankruptcy. They find that Brexit led to larger falls in stock prices, especially for EU banks. While we include firms in the financial industry in our analysis, as detailed below, our sample of firms covers a much broader set of industries. Further, we analyze the importance of differences across firms beyond their main market. The second study is Ramiah, Pham, and Moosa (2017) who estimate the cumulative abnormal returns across industries following the Brexit referendum, finding that the financial sector was particularly hard hit. Their analysis differs from ours in three key ways, however. First, their focus is on cross-industry variation in abnormal returns with no consideration of *why* the effects vary by industry nor how they differ across firms within an industry. In contrast, we show that the importance of GVCs to the firm explains a significant portion of this variation. When using only sector-fixed effects in our baseline

estimates, our regression results in an adjusted R-squared of .063; when also including our GVC controls, this rises to .463 indicating that a major part of the variation is firm-specific rather than industry-specific. Thus, our results point to a key role of firm-specific, within-industry variation that their analysis does not address. Second, they do not discuss the timing of the market's reaction to Brexit whereas we are able to demonstrate that it was a very rapid and persistent reaction. Third, they do not consider other markets whereas we also analyse the HDAX. Beyond this, our analysis extends both of these studies by considering five subsequent Brexit-related events, finding that the Brexit vote was by far the one that provoked the strongest reaction. Thus, our results contribute by providing a more nuanced framework for understanding the heterogeneous responses to Brexit.

In addition to the event study literature, our analysis is linked to the literature on global value chains. Here, a significant part of the discussion is given over to describing the fragmentation of production across borders using both case studies, such as Dedrick, Kramer, and Linden's (2010) analysis of the iPod's international production structure, and methods of describing the phenomenon in the aggregate, such as that in Baldwin and Lopez-Gonzalez (2015), Timmer, et al. (2014a), and Dietzenbacher, et al. (2013).[10] In addition to these descriptions, there exists a concurrent body of work estimating how trade and other policies affect the GVC. As one might expect from the surveys of Feestra (1989) and Amador and Cabral (2016), trade in intermediates is impeded by tariff and non-tariff barriers to trade. This evidence thus supports the expectation that Brexit and rising trade barriers has the potential to limit trade within a GVC. When combined with the estimates suggesting that firms which import intermediates are more productive than others, e.g. Halpern, Koren, and Szeidl (2015), Altomonte, Aquilante, Békés, and Ottaviano (2013), and Nickerson and Konings (2007), this suggests that Brexit will lower the productivity of affected firms, an effect that would potentially drive the negative abnormal returns in heavily European firms which we document. Finally, the results of Amiti, Itskhoki, and Konings (2014), who find that trade within a multinational's value chain is less impacted by exchange rate movements, could provide a rationale for our finding that large firms have higher abnormal returns in the wake of Brexit.

The rest of the paper proceeds as follows. Section 2 describes our data. In particular, it details how we construct our abnormal returns and discusses their pattern surrounding the referendum. It also describes our firm-level controls and the hypotheses we have for them. Section 3 presents our empirical approach for the second step of our estimation and contains our results. Our analysis of the additional events can be found in Section 4. Finally, Section 5 concludes.

2 Data

In our analysis we utilize two data sets, each of which combines data from multiple sources. As in Blonigen, Tomlin, and Wilson (2004), we use this information in two steps, first to estimate a firm's abnormal return and then to examine how this varies with firm characteristics. Here, we discuss each of these, and our methodology, in turn.

[10] Timmer, et al. (2014b) provide a recent overview of this literature.

2.1 Abnormal Returns

First, we use data on companies listed on London Stock Exchange. There are almost 1,400 companies listed on the main market of the Exchange.[11] The largest companies are grouped into two main indices: the FTSE 100 Index and the FTSE 250 Index, with the FTSE 350 being their union. The FTSE 100 represents the performance of the 100 companies with the highest market capitalization, a group which comprises around 85% of the Exchange's total value. The next 250 largest firms (the FTSE 250) make up a further 12.5% of the total Exchange's market capitalization. Both of these groups vary over time as the sizes of individual firms vary. We use the list of FTSE 350 companies from the Exchange as of October 2016 and maintain this set of firms through all of our analysis.[12] This was then trimmed to 339 firms due to lack of firm-level GVC controls as explained below. This was also a problem for the bulk of the non-FTSE 350 firms on the Exchange which is why we focus on the 350.[13]

For this group of firms, we import stock price data from Yahoo Finance (2017) which provides us with the adjusted closing price for each company.[14] This is then used to construct daily returns to which we then apply an event study methodology. The intuition of this approach is that, given the efficiency of the market, a firm's return should reflect the market return (i.e. you cannot consistently beat the market). During an "event", however, investors may shift expectations about this firm's future performance causing its actual return to differ from the expectation based on the return in the market as a whole. These events can be idiosyncratic, such as the announcement that a firm will expand operations, or common, as is the case with Brexit which affects all firms. Thus, the abnormal return gives an approximate indication of whether an investor expects a given firm to perform better or worse than expectations.

To estimate the abnormal return, one uses data from an "estimation window" prior to the event along with returns during the event (the "event window"). While there are several approaches to doing so, we implement the commonly used seemingly unrelated regressions (SUR) approach to the market model.[15] In this, for a given firm i, we estimate its return on day τ, $R_{i\tau}$, as a function of the market's return, $R_{m\tau}$, and a dummy variable $Event_\tau$ which equals 1 for trading days during the event window:

$$\begin{aligned} R_{i\tau} &= \alpha_i + \beta_i R_{m\tau} + \gamma_i Event_\tau + \varepsilon_{i\tau} \\ E(\varepsilon_{i\tau}) &= 0 \quad var(\varepsilon_{i\tau}) = \sigma^2_{\varepsilon_i} \end{aligned} \tag{1}$$

where $\varepsilon_{i\tau}$ is the mean zero, constant variance error term. The estimate of γ_i is then the estimate of the abnormal return for firm i during the event, i.e. the average deviation between the actual return and the expected return based on the market during the event window. When the event is a single day, γ_i is an abnormal return (AR). When the event window is longer than one day, to calculate the cumulative abnormal return (CAR), one then multiplies

[11] See London Stock Exchange (2010) for details.

[12] This list can be found at `http://www.londonstockexchange.com`.

[13] These non-350 firms are also not traded on many of the days during the estimation windows.

[14] The adjusted closing price alters the closing price to account for factors such as dividends, stock splits and new stock offerings. See Yahoo Finance (2017) for details.

[15] See Armitage (1995), MacKinlay (1997), or Corrado (2011) for overviews of different estimation methods. A handful of recent examples using the SUR method include Doidge and Dyck (2015), Schäfer, Schnabel, and Weder di Mauro (2016), and Schiereck, Kiesel, and Kolaric (2016) to name but a few.

γ_i by the number of days in the window. This AR/CAR can be positive or negative. A negative CAR means that, relative to what the overall market's performance during the event would suggest, the firm's return was lower than expected. Conversely, a positive CAR means that the firm did better than one would expect. Note that this does not necessarily mean a positive return for the firm. Since the market fell following the referendum, a positive CAR can (and for some firms does) mean that they had a negative return but that this negative return was not so bad as one would expect based on the overall market's performance. With this in mind, to minimize clumsy exposition we will use the terms "a decline in the AR/CAR" and "doing worse relative to expectations" interchangeably. Our primary goal in this study is to examine to what extent these deviations from expectations as embodied in the abnormal returns vary with measures of a firm's GVC.

Given the common nature of our event, our estimation uses Zellner's (1962) SUR approach for our 339 firms.[16] Note that in our case where the control variables are the same for all firms and we are not testing cross-equation restrictions, this methodology is equivalent to OLS (see Woolridge (2010) for discussion).[17] In addition to our estimate of the size of the CAR, this procedure gives us the significance of that estimate, that is, whether the firm had a statistically significant abnormal return during the event window. In our analysis we use an estimation window of 150 trading days, starting 160 trading days before the event (which for the June 23 referendum was 4 November 2015) and finishing 10 trading days before the event (9 June 2016). For subsequent events, we use an analogous estimation window, where the start and end dates are shifted to 160 and 10 trading days before the specific event. In unreported results, we maintain the 4 November 2015 to 9 June 2016 estimation window for all events, something of potential interest since for subsequent events the moving estimation window includes prior events. This, however, had no qualitative and only a small quantitative impact on the results presented here. These are available on request. The data on the market capitalization-weighted average market return for the FTSE 350 comes from Investing.com as Yahoo Finance did not have it available.[18]

Table 1 reports the simple average of our estimated ARs for the days leading up to the June 23 referendum and shortly thereafter.[19] As can be seen, prior to the referendum, the ARs were comparatively small, with the average below 1%. During the two trading days following the announcement of the results, however, ARs were markedly more negative on average.[20, 21] In addition, the standard deviation of the AR across firms rose markedly, indicating the very different experiences across firms. After that, however, the market calmed considerably, with average ARs again falling below 1%. The standard deviation of ARs, however, remained

[16] An alternative approach estimates α_t and β_i during the estimation window only and retrieves γ_i as a residual in an out-of-sample prediction during the event window. In the Appendix, we show results from this alternative which are nearly identical to those here.

[17] Note that this differs from Schiereck, Kiesel, and Kolaric (2016), who compare the estimated abnormal returns between UK and non-UK banks or Ramiah, Pham, and Moosa (2017) who do so across industry categories within the SUR framework. In contrast, we use the estimated CARs in a second stage estimation.

[18] This can be found at `http://www.investing.com`.

[19] In these estimations each day was treated as a one day event in Equation 1 with a common estimation window.

[20] Note that as June 25 and 26 were weekend days, the 27th was the second trading day following the announcement of the results.

[21] Note that the market return is a market capitalization weighted average across the 350 firms in the FTSE 350 whereas our averages are simple ones across the 339 firms in our sample. Thus, there is no inherent reason to expect our averages to be zero in line with the market model.

slightly elevated, indicative of some continuing disruption in the market. Thus, the summary statistics on our ARs suggest that there was indeed an uptick in market turbulence as embodied in our ARs following the referendum, but that this was largely confined to the first two trading days after the referendum.

Table 1: Abnormal Returns Surrounding the 23 June Referendum

	Mean	St. Dev.	Min	Max
20-June-16	0.74%	2.28%	-6.53%	13.15%
21-June-16	-0.09%	1.7%	-13.13%	13.06%
22-June-16	0.04%	1.48%	-8.26%	8.19%
23-June-16	0.44%	1.44%	-5.88%	5.34%
24-June-16	-3.41%	7.49%	-28.28%	13.53%
27-June-16	-3.8%	5.96%	-27.68%	8.37%
28-June-16	0.92%	2.95%	-15.79%	12.87%
29-June-16	0.36%	2.88%	-6.75%	19.34%
30-June-16	0.08%	2.37%	-7.44%	15.05%
14-July-16	0.27%	2.01%	-10.97%	16.71%
21-July-16	0.12%	2.65%	-13.68%	28.21%

Source: Own calculations based on Yahoo Finance (2017).

In Table 2, we report the number of statistically significant ARs for the dates surrounding the referendum with a further breakdown into those that were significantly positive (i.e. firms that did significantly better than expected) and those that were significantly negative.[22] This again shows the very swift – and significant – reaction of the market. In the four days prior to the announcement of the referendum's results, there were on average 38 significant ARs per day, with this number even smaller for the three days leading up to the vote. In contrast, on the two days after the results came out, there were six times as many significant ARs (with the large share being significantly negative). After that, the number of significant ARs fell, although they are still somewhat elevated relative to the days prior to the announcement. This again shows that a major part of the market's reaction was capitalized into share prices in the two days following the announcement.

As mentioned above, while a significantly positive AR indicates that a firm did better than expected, it is still possible that its return was negative. On 24 June, 61 of our 339 firms saw their stock prices rise (a positive return). In our data, all of these had positive ARs on that day since the market overall fell. However, as Table 2 indicates, not all of them did significantly better relative to expectations in a statistical sense. For future use, we will denote those 61 firms with positive returns on 24 June (regardless of whether their ARs were significant or not) as gainers; the rest of the firms are denoted as losers.

In addition to the daily AR, one can examine the cumulative abnormal return (CAR) over a specified window. The advantage to examining the CAR is that it helps to account for overshooting in a firm's daily return. For example, if on day t a firm has a negative AR but has a positive one on day $t+1$, examining the CAR across those two days gives the opportunity for observing a net zero effect, i.e. a correction to the firm's return over the two

[22] This is obtained from the SUR regression, where we use the 10% significance level to determine whether or not an AR is significant. Corrado (2011) provides a discussion of various methodologies for doing this.

Table 2: Significant ARs Surrounding the 23 June Referendum

Date	Total Significant ARs	Positive AR	Negative AR
20-June-16	80	70	10
21-June-16	21	13	8
22-June-16	25	14	11
23-June-16	24	18	6
24-June-16	229	64	165
27-June-16	217	38	179
28-June-16	98	82	16
29-June-16	76	51	25
30-June-16	76	38	38
14-July-16	39	25	14
21-July-16	29	14	15

Source: Own calculations based on Yahoo Finance data (2017).

days so that over the longer window there is no cumulative abnormal return. Alternatively, if the net effect remains negative this would suggest that the firm underperforms relative to expectations even if there is a partial correction. We use seven different event windows for our CARs, starting on the day of the referendum and then extending to the first day of trading after the results are known all the way up to four weeks after the results were announced. The summary statistics for these CARs are in Table 3.

Table 3: Descriptive Statistics for CARs

Window	Obs.	Mean	Std. Dev.	Min	Max
(-1,0)	339	-2.84%	7.03%	-27.59%	13.92%
(-1,+1)	339	-6.37%	11.54%	-44.4%	21.68%
(-1,+2)	339	-5.49%	10.66%	-61.3%	20.24%
(-1,+3)	339	-5.56%	10.88%	-43.75%	26.01%
(-1,+4)	339	-5.8%	12.21%	-49.0%5	28.77%
(-1,+14)	339	-4.76%	12.9%	-42.92%	40.56%
(-1,+19)	339	-4.63%	12.83%	-44.24%	35.41%

Source: Own calculations based on Yahoo Finance data (2017).

These CARs indicate that the average firm in our sample performed worse than expected during the days after the referendum. Further, although these shortfalls grew smaller in magnitude, they remained four weeks after the referendum. Putting these results and those of the daily ARs found in Table 1 together, the picture they paint is one in which the average firm did markedly worse relative to expectations in the two days following the referendum and that these losses were not regained over the next month.[23]

[23] Again, note that these are simple averages across firms, not the weighted average used when constructing the market return.

2.2 Firm Controls

Our main goal is to investigate how these firm ARs and CARs relate to firm-specific characteristics, particularly those related to GVCs. Here, we draw from three key sources.

First, we utilize ownership data from Bureau van Dijk's Orbis (2016) dataset which covers worldwide activity. While we would prefer to have data on each firm's trade patterns to measure GVC activity, such confidential customs data were not available to us. As an alternative, based on the evidence provided by Hanson, Mataloni, and Slaughter (2005) which shows the significant role of intra-firm trade in multinational's GVCs, we instead use information on the location of the affiliates of the multinational of which the firm is a part.[24] For each of the FTSE 350 firms, we attempted to match it to a global ultimate owner (GUO) in the Orbis data. We were unable to do so for 11 firms, which is why our analysis utilizes only 339 firms. 325 of our 339 listed firms were their own UK-based GUOs.[25] For each GUO, we then constructed the number of affiliates it owned in the UK, in the rest of the EU, and elsewhere (not counting the GUO itself).[26] We then calculated the share of its affiliates in the UK and in the rest of the EU. Summary statistics from this are reported in Table 4. Note that the mean number of affiliates is 176 affiliates, a number driven in part by a firm with 3,393 affiliates worldwide.[27] The median firm in our sample has 81 affiliates. Of the 339 firms, 58 are entirely UK-based. When omitting those 58 firms we obtain comparable results.[28] While it would have been desirable to control for affiliate size (i.e. to use the share of employment or investment in a country rather than the share of affiliates), missing data in Orbis made this infeasible.

Table 4: Summary Statistics for Affiliate Ownership

Variable	Obs.	Mean	Std. Dev.	Min	Max
No of affiliates	339	173.4	304.1	1	3,392
No of EU affiliates	339	28.4	67.3	0	908
No of non-EU affiliates	339	74.6	181.6	0	1,909
No of UK affiliates	339	70.3	106.3	0	892
Share of affiliates in the UK	339	55.1%	34.4%	0%	100%
Share of affiliates in the EU	339	14.3%	17.7%	0%	100%
Share of affiliates non-EU	339	30.6%	30.0%	0%	100%

Source: Own calculations based on Orbis data (2017).

Based on the results of Hanson, Mataloni, and Slaughter (2005), who find that trade barriers significantly hamper trade in intermediates within US multinationals, our expectation is that Brexit is expected to impede the efficient working of the firm's GVC. As such, relative to the average firm, investors would be particularly keen to sell shares of firms for which the UK and the EU comprise a larger share of the firm's GVC which we proxy by the share of

[24] For statistics on intra-firm trade for British firms, see Liu, Schmidt-Eisenlohr, Guo (2017).

[25] Of the remainder, 7 GUOs were in Ireland, 3 in Bermuda, and 1 each in Canada, Germany, Spain, and the Cayman Islands. When restricting the sample to only British GUOs, the results are comparable to those reported. These can be found in the Appendix.

[26] We define ownership as when at least 50% of an affiliate is owned by another firm.

[27] Our results are robust to omitting this outlier.

[28] These results are in the Appendix. Note that for these firms, the depreciation of the Sterling measure we use was zero.

affiliates in those regions. In particular, given that Brexit requires the UK to negotiate new trade deals not just with the EU but with other countries as well, we anticipate this effect to be larger for the UK share of affiliates than the EU share of affiliates. This yields our first hypothesis.

Hypothesis 1 *As the share of affiliates in the UK and the EU grow, the abnormal return and CAR should fall (so that the firm does worse relative to expectations). This decline should be more severe for the share in the UK.*

In addition to trade barriers, Brexit has the ability to affect the GVC via exchange rate fluctuations. In particular, the British Pound fell markedly against other currencies immediately following the referendum, declining by 7.8% against the dollar and by 5.8% against the Euro on the first day after the results were announced. As the Sterling declines relative to the source of the firm's intermediate inputs, this increases costs and lowers imports. Given the results of Halpern, Koren, and Szeidl (2017) who find a positive relationship between imports of intermediates and productivity, we expect this to lower the firm's return. On the other hand, as the Sterling falls this increases the Pound-denominated benefit from exporting (be that an intermediate or a final good). This increase in the value of exporting might generate expectations of an improvement in the firm's future value. An additional positive effect from a depreciation could arise from the firm's overseas affiliates. As the Sterling falls, this would increase the Pound value of repatriated profits, thus boosting the Pound-denominated value of the parent firm. Combining these, the net effect of a devaluation is ambiguous and depends in part on whether the import or export effect dominates.

To estimate this net effect, we construct the average depreciation of the Sterling against other currencies where the firm has affiliates.[29] We obtain our exchange rate information from Financial Times (2017). Note that this is a depreciation (a decline in the Sterling) so that a higher value of the depreciation is a larger percentage fall in the Pound. When we examine CARs, the depreciation measure we use is the exchange rate change from the start of the event window to the end, meaning that as we increase the length of the CAR, we increase the period of time where we look at the exchange rate change. In unreported results we also used just the depreciation over 23-24 June for all CARs. This gave us similar results to those reported here. This leads to our second hypothesis.

Hypothesis 2 *If the importance of imported intermediates dominates, then the larger the depreciation of the Sterling relative to other key currencies, the worse the firm does relative to expectations. If the importance of exports dominates, then the larger the depreciation the better its relative performance.*

[29] While it is potentially preferable to instead weight this by, say, the share of affiliates the firm has in a given currency, this weighted average depreciation was extremely correlated with the share of UK affiliates as discussed in the Appendix. As shown there, although this yielded comparable results for the EU share of affiliates, as expected this increases standard errors and reduces significance of other variables. In unreported results, we used the depreciation only for the country which had the greatest share of the firm's affiliates. As a further check, we estimated results using this alternative unless the greatest share was in the UK, in which case we used the depreciation of the second highest share country. Both of these gave results comparable to those reported here. Note that it is necessary to weight the exchange rate movements by firm-specific variables, otherwise the exchange rate movement would be the same across firms and subsumed into the constant.

To examine this exchange rate issue in greater detail, in some specifications we also use information from the OECD (2012) which attempts to quantify the importance of GVCs across industries. In particular, we make use of two measures: the forward participation, which is the ratio of exports of intermediates to total exports, and the backwards participation, which measures the ratio of imported inputs to overall exports. For both of these, we use the values for the UK in 2009 (the most recent year in which they were available). Further, these are available by rough industry groups which we then match to each of our 339 firms by hand (details available on request). Given our above predictions, a larger depreciation will have a more negative effect on the value of a firm when its backwards participation, and thus the importance of imported intermediates, is higher. For the forwards participation the expectation is less clear cut since the depreciation makes the exporting of both intermediates and final goods relatively more profitable.

Hypothesis 3 *The impact of a depreciation on the abnormal return and CAR should be smaller for firms with a higher backwards participation, i.e. the interaction between these is negative.*

Finally, we include two measures of the size of the firm, its market capitalization and its number of affiliates. Given the results of Amiti, Itskhoki, and Konings (2014), we might expect that larger firms are better able to ride out the waves generated by Brexit.[30] Thus, we expect that the larger the market capitalization, the better a firm does relative to expectations. However, larger firms are also more costly to manage. In particular, when the firm has a large number of affiliates, the added complications of Brexit may increase those costs, especially when those affiliates form part of the GVC. If more costly GVCs are more vulnerable to the anticipated disruption of Brexit, this might counter the positive effect of overall firm size. This leads to our final two hypotheses.

Hypothesis 4 *The higher the firm's market capitalization, the higher the abnormal return and CAR, i.e. the better its performance relative to expectations.*

Hypothesis 5 *As the number of affiliates rises, the lower the abnormal return and CAR.*

Data on market capitalization comes from the London Stock Exchange and Investing.com and is measured as logged millions of Pounds. The number of affiliates comes from Orbis (2016) and is also measured in logs.[31] Summary statistics on the depreciation between June 23 and 24, the forwards and backwards participations, market capitalization, and the number of affiliates are in Table 5.[32]

Given the results of Ramiah, Pham, and Moosa (2017) showing differences in CARs across industries and the fact that our controls likely vary systematically across industries, it is important that we include sector dummies in order to focus on within-sector variation for identification. In Orbis, we are provided 2-digit NACE codes for our firms. However, of the 63 2-digit NACE codes covered by the 339 firms in our data, eleven industries have only one firm and another thirteen have only two. In total, half of the industries have three observations

[30] This was also suggested by some market analysts, e.g. Wright (2016). With this in mind, in addition to market capitalization we included a FTSE 250 dummy which was never significant and therefore omitted.

[31] Note that we do not log the other controls as they include zeros.

[32] Details on the depreciations for other event windows are available on request.

Table 5: Summary Statistics for Additional Controls

	Obs.	Mean	Std. Dev.	Min	Max
Depreciation	339	0.048	0.024	0	0.073
Market Capitalization	339	7.83	1.18	6.08	11.94
Number of Affiliates	339	4.16	1.65	0	8.13
Backwards	339	0.97	0.91	0	4.4
Forwards	339	2.73	2.17	0.2	6.5

Source: Own calculations based on Orbis data (2017).

or less. Thus, there is limited within-NACE category variation. As an alternative, we map the 2-digit NACE categories into the thirteen categories provided by the European Commission (EC) as reported in Table 6.[33] Nevertheless, as a robustness check, we instead use the 2-digit NACE dummies for our industries.[34]

Table 6: Observations by Sector

	Num. of obs.	Share of obs.
High tech manufacturing	15	4.42%
Medium tech manufacturing	19	5.6%
Medium-low tech manufacturing	14	4.13%
Low tech manufacturing	25	7.37%
Knowledge-intensive market services	22	6.49%
Less knowledge-intensive market services	83	24.48%
High-tech knowledge-intensive services	16	4.72%
Other knowledge-intensive services	16	4.72%
Other less knowledge-intensive services	7	2.06%
Construction	11	3.24%
Finance and insurance	88	25.96%
Utilities	8	2.36%
Mining	15	4.42%

Source: Own calculations based on Orbis data (2017).

3 Determinants of Abnormal Returns

With the above hypotheses in mind, we now investigate the way in which abnormal returns are correlated with firm characteristics in two ways. First, we examine whether a firm has a statistically significant AR on 24 June using an ordered probit as a function of the above firm controls. Second, we estimate how the size of the AR/CAR is correlated with firm characteristics. While studies such as Schiereck, Kiesel, and Kolaric (2016) or Ramiah, Pham, and Moosa (2017) have compared post-Brexit CARs across discrete groups, e.g. EU/UK

[33] Details can be found at `http://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an2.pdf`.

[34] An additional reason to not use the NACE categories is that, when using constructed variables such as return variance in the robustness checks, the insufficient within-group variation when using NACE dummies prevented us from boostrapping the errors.

or industries, our analysis differs in that we estimate the impact of non-categorical firm characteristics and their role in within-group heterogeneity.

For the ordered probit, we have three categories, a significantly negative AR, an insignificant AR, and a significantly positive AR (with the categories ascending in that order).[35] We therefore estimate:

$$\begin{aligned} AR_i = f(&\beta_0 + \beta_1 UK_i + \beta_2 EU_i + \beta_3 Depreciation_i \\ &+\beta_4 MktCap_i + \beta_5 NumAff_i + \alpha_s) + \epsilon_i \end{aligned} \tag{2}$$

where $AR_i = \{0, 1, 2\}$, i.e. the category as it depends on the UK share of affiliates, the EU share of affiliates, the depreciation of the Sterling, the firm's market capitalization, its number of affiliates, the vector of sector dummies, and an error term.

For the size estimations, we estimate a comparable linear regression:

$$\begin{aligned} CAR_{i,\underline{\tau},\overline{\tau}} = &\beta_0 + \beta_1 UK_i + \beta_2 EU_i + \beta_3 Depreciation_{i,\underline{\tau},\overline{\tau}} \\ &+\beta_4 MktCap_i + \beta_5 NumAff_i + \alpha_s + \epsilon_i \end{aligned} \tag{3}$$

where the dependent variable is now the value of the CAR over the event window running from $\underline{\tau}$ to $\overline{\tau}$ with the different event windows described in Table 3. Note that where 24 June is $t = 0$, the day of the event, the depreciation is from the beginning of the event window ($t = -1$ in most specifications) to the final date in the event window. Given that our dependent variable is constructed, as discussed by Lewis and Linzer (2005), this has the potential for introducing heteroskedasticity which can be corrected for using the White robust error correction.[36]

3.1 Significance of AR

In Table 7 we present the estimates from the ordered probit results for the AR on the first trading day following the referendum, i.e. the AR for 24 June. Column (1) utilizes the full sample, column (2) does so just for the gainers (who, since they had a positive return on a day where the market fell, did not have a significantly negative AR), and column (3) does so for the losers. Underneath the robust standard errors, which are in parentheses, italicized numbers indicate the estimated elasticities evaluated at the sample mean.

As can be seen, across all three groups, the coefficients on the two affiliate share variables are significantly negative, meaning that the greater the share of affiliates a firm has in the UK or the EU, the lower the predicted category value, i.e. the more likely they are to have a significantly negative AR (i.e. to have significantly underperformed relative to expectations). Furthermore, in line with Hypothesis 1, the point estimate for the UK is larger for both the full sample and the sample with losses, although we cannot reject the null hypothesis of equal coefficients. The depreciation of the Sterling, however, is never significant, perhaps reflecting

[35] Given the natural order of these categories, we use ordered rather than multinomial probit.

[36] Alternatively, they suggest that FGLS may be used. In a Monte Carlo simulation using event study data, Karafiath (1994) finds that OLS with a heteroskedasticity correction works just as well as other estimators in estimations with sufficiently many observations (at least 50 in those simulations). Therefore, given that we have 339 observations we proceed using robust standard errors.

Table 7: Ordered Probit Estimates

	(1) All	(2) Gains	(3) Losses
Share of UK Affiliates	-2.064***	-2.028**	-1.993***
	(0.359)	(0.947)	(0.447)
	1.124	*1.012*	*0.621*
Share of EU Affiliates	-1.556***	-3.801***	-1.497***
	(0.419)	(1.373)	(0.526)
	0.22	*0.703*	*0.114*
Depreciation	0.420	-20.29	2.032
	(6.256)	(22.92)	(6.785)
	-0.02	*1.508*	*-0.05*
Market Capitalization	0.299***	0.554*	0.1000
	(0.0976)	(0.288)	(0.112)
	-2.313	*-6.378*	*-0.406*
Number of Affiliates	-0.172*	0.0459	-0.103
	(0.0951)	(0.230)	(0.0961)
	0.707	*-0.253*	*0.228*
Cutoff between $\{1, 2\}$	-0.226	-2.938	-1.110
	(0.774)	(2.605)	(0.896)
Cutoff between $\{0, 1\}$	1.052		0.571
	(0.792)		(0.903)
Observations	339	61	278

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Italicized numbers indicate estimated elasticities. Categories are coded so that 0 is for significantly negative AR, 1 is for insignificant AR, and 2 is for significantly positive AR, so that the cutoff between $\{0, 1\}$ is that between a significantly negative AR and an insignificant AR.

the conflicting effects it can have as indicated in Hypothesis 2. For the full and gainers-only samples, we find results consistent with Hypothesis 4. The number of affiliates, however, is only significant in the full sample and then only weakly so, where its sign suggests that more affiliates may be an indication of a more vulnerable GVC.

While these results indicate the direction of the significance of an AR, there is important information it does not address. In particular, it says nothing about the size of that AR, that is, the gap between actual and expected returns. This is the issue we address in in our subsequent regressions and is the main focus of our analysis.

3.2 Size of CAR

In Table 8, we present our estimates for seven different event windows. Where 24 June is $t = 0$, our windows run from $t = -1$ up to $t = 4$, i.e. up to five trading days after the referendum, then $t = 14$ in column (6), and concluding with $t = 19$ in column (7). By using these longer event windows, we are allowing for intermediate term market reversals in which a firm may be shunned immediately after the referendum, meaning a negative CAR during a short window, but then the market reverses its negative outlook so that its CAR is close to

zero during a longer window.[37] That said, across all these windows, we find very comparable results.

In particular, in line with Hypothesis 1 we find significantly negative coefficients on the UK and EU affiliate shares. Using the results from column (1), these would suggest that a 10% increase in the average firm's UK affiliate share (i.e. a shift of 5.5% of its affiliate structure from outside the UK or the EU into the UK) would result in a 20.8% lower CAR.[38] In comparison, a 10% increase in the average EU share (a shift of only 1.4% of the affiliate structure) would result in a 5% lower CAR. This difference however is due to the lower mean EU affiliate share; a shift of 5.5% of the affiliate structure from outside Europe into the EU would result in a 19.1% lower CAR. Thus, as expected, the impact for the UK is greater than that for the EU, however, in no case were we able to reject the null hypothesis of equality. Thus, these GVC impacts are of economic as well as statistical significance.

Turning to the depreciation variable, we again to find no significant impact of the change in the Sterling relative to the currencies where the firm's affiliates are located. That said, using column (1)'s results, a 10% smaller depreciation relative to the sample mean would translate into an 8% lower CAR. Thus, the depreciation effects appear secondary in both magnitude and significance to the location of affiliates. It must be remembered, however, that as per Hypothesis 2 this might be the result of concealed countervailing effects, an issue we explore below.

As for market capitalization, we find a positive coefficient in all windows, with this effect significant for windows of intermediate length. Recalling that this is measured in logs, a 10% increase in the firm's size would result in a 1.9% larger CAR.[39] This is consistent with Hypothesis 4, albeit it indicates that the elasticity of the CAR with respect to firm size is small compared to the other variables. Finally, the number of affiliates is significantly negative in all event windows, suggesting that in line with Hypothesis 5, firms with more affiliates may be more at risk from the coordination complications introduced by Brexit. Here again the estimated magnitude is fairly small, with the coefficient in column (1) indicating that a 10% increase in the number of affiliates (an introduction of approximately seventeen more affiliates) would mean a CAR that is 3.1% lower.

Taken together, these estimates suggest four things. First, the CARs are not random, rather they are significantly correlated with firm characteristics. Further, this is not simply due to industry differences as we include industry dummies. Thus, this yields results not covered in the analysis of Ramiah, Pham, and Moosa (2017).[40] Second, these effects are consistent with our hypotheses. In particular, we find the strongest impacts arising from the distribution of affiliates where the results are indicative of the expectation that increasing barriers between the UK and the EU are likely to cause significant disruptions for firms' GVCs. Third, the effects persist over long event windows, with most of the impacts still significant even four weeks after the announcement of the referendum's outcome. Even though the market as a whole recovered the bulk of its value within a week of the event, this implies persistent relative differences across firms. In particular, it suggests that even if there was some overshooting in the flight from firms whose GVCs are expected to be negatively impacted,

[37] The choice of window length is somewhat arbitrary; ours are set so that we cover windows of one week of trading, three weeks of trading, and a month of trading.

[38] That is, 5.5 times the estimated coefficient (-0.107) divided by the mean of the CAR (2.84).

[39] That is, the coefficient divided by the sample mean for the CAR as size is already in logs.

[40] We discuss this in more detail below where we expand our industry classification.

Table 8: June 24; Size of CAR

	(1) (-1,0)	(2) (-1,+1)	(3) (-1,+2)	(4) (-1,+3)	(5) (-1,+4)	(6) (-1,+14)	(7) (-1,+19)
Share of UK Affiliates	-0.107***	-0.160***	-0.137***	-0.141***	-0.153***	-0.154***	-0.180***
	(0.0148)	(0.0238)	(0.0220)	(0.0226)	(0.0260)	(0.0262)	(0.0298)
Share of EU Affiliates	-0.0987***	-0.150***	-0.135***	-0.157***	-0.169***	-0.164***	-0.137***
	(0.0198)	(0.0321)	(0.0298)	(0.0328)	(0.0379)	(0.0367)	(0.0410)
Depreciation	0.471	0.496	0.590	0.601	0.637	0.528	0.439
	(0.313)	(0.376)	(0.440)	(0.463)	(0.464)	(0.378)	(0.408)
Market Capitalization	0.00547	0.0158**	0.0161**	0.0169**	0.0158*	0.0157*	0.00750
	(0.00418)	(0.00691)	(0.00700)	(0.00717)	(0.00861)	(0.00851)	(0.00777)
Number of Affiliates	-0.00870*	-0.0131*	-0.0141*	-0.0152*	-0.0171*	-0.0163*	-0.0152*
	(0.00449)	(0.00766)	(0.00801)	(0.00806)	(0.00960)	(0.00906)	(0.00871)
Constant	0.0285	-0.0262	-0.0256	-0.0114	0.0121	0.0153	0.0884
	(0.0330)	(0.0529)	(0.0536)	(0.0533)	(0.0628)	(0.0606)	(0.0643)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	339	339	339	339	339	339	339
Adjusted R-squared	0.435	0.439	0.397	0.399	0.378	0.377	0.367

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Depreciation refers to the depreciation within each event window.

the subsequent correction in the market still results in a net negative comparison of firm's actual relative to expected returns. Finally, by examining the adjusted R-squareds across the different windows, we see that the ability of our controls to explain the size of the CAR diminishes in the longer windows. This then builds on the above discussion indicating that the primary market reactions were during the first two days of trading (more on this below).

In Table 9 we repeat this specification but alter the event window so that the CARs are calculated beginning with $t = -2$, i.e. 22 June, the day before the referendum vote. We do so because of the possibility that investors may have begun to alter their expectations before the result's announcement if unofficial word began to spread regarding the outcome of the referendum. An alternative interpretation is one where the date of the event is 23 June (the referendum itself) rather than 24 June (the first day of trading after the result's announcement). In any case, with the exception of the number of affiliates results, which now slip outside the traditional bounds of significance, the main findings hold.

In Tables 10 and 11 we repeat the process of Table 8 for those firms that had a positive return on 24 June and those that did not (comparable to columns 2 and 3 of Table 7).[41] In both, we find negative coefficients for the UK and EU affiliate shares which are typically statistically significant. There are two notable differences, however. First, although the point estimates for the UK share is higher for the losers in Table 11 we find the opposite ranking for the gainers in Table 10. In addition, this difference in coefficients is statistically significant for the gainers. That said, the results point to the notion that regardless of whether a firm's stock price rose or fell on the first day after the referendum, consistent with Hypothesis 1, the greater the European orientation of its affiliate structure the worse it did relative to expectations. The second difference is that although the UK share effect is significant for

[41] Note that we define these categories as the change on 24 June, even for the longer windows. This is because some firms gained and lost during a multi-day window, making it unclear how to classify them.

Table 9: June 24; Size of CAR, Early Event Window

	(1) (-2,0)	(2) (-2,+1)	(3) (-2,+2)	(4) (-2,+3)	(5) (-2,+4)	(6) (-1,+14)	(7) (-2,+19)
Share of UK Affiliates	-0.105***	-0.155***	-0.135***	-0.139***	-0.151***	-0.200***	-0.177***
	(0.0144)	(0.0231)	(0.0213)	(0.0224)	(0.0257)	(0.0287)	(0.0293)
Share of EU Affiliates	-0.103***	-0.153***	-0.141***	-0.163***	-0.175***	-0.162***	-0.144***
	(0.0205)	(0.0323)	(0.0303)	(0.0336)	(0.0387)	(0.0382)	(0.0404)
Depreciation	0.388	0.428	0.535	0.547	0.601	0.305	0.439
	(0.327)	(0.383)	(0.454)	(0.487)	(0.483)	(0.365)	(0.424)
Market Capitalization	0.00522	0.0154**	0.0159**	0.0168**	0.0158*	0.0108	0.00753
	(0.00401)	(0.00665)	(0.00681)	(0.00705)	(0.00849)	(0.00817)	(0.00760)
Number of Affiliates	-0.00678	-0.0110	-0.0123	-0.0134*	-0.0153	-0.0166*	-0.0139
	(0.00425)	(0.00729)	(0.00776)	(0.00789)	(0.00942)	(0.00865)	(0.00854)
Constant	0.0267	-0.0278	-0.0278	-0.0139	0.00883	0.0803	0.0823
	(0.0330)	(0.0523)	(0.0532)	(0.0538)	(0.0632)	(0.0607)	(0.0634)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	339	339	339	339	339	339	339
Adjusted R-squared	0.404	0.425	0.387	0.386	0.368	0.407	0.361

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Depreciation refers to the depreciation within each event window.

the losers even a month after the referendum, its significance begins to fade for the gainers within a week of the referendum and disappears a month later. Thus, for those firms that saw their price rise on 24 June, being heavily oriented towards the UK was penalized in early trading but that underperformance was erased a month later. Beyond this difference, the market capitalization and number of affiliates are only significant for the size of the CAR for the gainers. Thus, as with the full sample results, it appears that the most important factors for the CAR are the share of affiliates a firm has in the UK or the EU and that this is true for both gainers and losers.

As discussed in Table 2, the bulk of the market response appeared to have occurred in the two trading days after the referendum's results were known. Furthermore, within five trading days, the FTSE 350 had recovered its overall value. Nevertheless, the CAR results of Table 8 indicate that, even as the market as a whole regained its losses, not all firms did so equally, with some overperforming relative to expectations and others underperforming even a month later. To explore the timing of the market's recovery, Table 12 presents estimates for the day-by-day AR, rather than the CAR over the event window.

As can be seen, on 23 June, the day of the referendum, firms' ARs were correlated with the share of EU affiliates and the two size variables in a manner consistent with the estimates in Table 8. The estimated coefficients, however, are a mere 1% of what was found there. This suggests that, to the extent that the market was preparing for a pro-Brexit vote on the day of the referendum, such reactions were very slight. In contrast, on the first two trading days after the outcome was known, 24 and 27 June, the results are comparable to the baseline specification with heavily British and/or EU firms doing worse than expected. Notably, these effects begin to fade out almost immediately, with the estimated coefficients for the share variables half as big on the 27th as on the 24th. Similarly, although larger firms and those with a larger depreciation did better relative to expectations on the 24th, no significant difference was found on the 27th. On the 28th, we see a reversal in the pattern since there

Table 10: June 24; Size of CAR, Gainers Only

	(1) (-1,0)	(2) (-1,+1)	(3) (-1,+2)	(4) (-1,+3)	(5) (-1,+4)	(6) (-1,+14)	(7) (-1,+19)
Share of UK Affiliates	-0.0560***	-0.0908***	-0.0747***	-0.0758***	-0.0732*	-0.0681*	-0.0352
	(0.0158)	(0.0261)	(0.0249)	(0.0282)	(0.0393)	(0.0365)	(0.0560)
Share of EU Affiliates	-0.137***	-0.211***	-0.220***	-0.243***	-0.235**	-0.235**	-0.168**
	(0.0245)	(0.0329)	(0.0517)	(0.0822)	(0.0948)	(0.0959)	(0.0763)
Depreciation	-0.0664	-0.0858	0.0227	-0.0146	0.169	0.247	1.074
	(0.317)	(0.382)	(0.396)	(0.522)	(0.622)	(0.490)	(1.198)
Market Capitalization	0.00434	0.0202***	0.0161***	0.0149**	0.0182**	0.0185**	0.00658
	(0.00293)	(0.00492)	(0.00423)	(0.00616)	(0.00833)	(0.00829)	(0.0165)
Number of Affiliates	-0.00465*	-0.0119**	-0.00992**	-0.00904	-0.0105	-0.0113	-0.0161
	(0.00250)	(0.00446)	(0.00397)	(0.00556)	(0.00747)	(0.00709)	(0.0204)
Constant	0.0766**	0.0112	0.0411	0.0616	0.0282	0.0208	0.0690
	(0.0325)	(0.0548)	(0.0512)	(0.0616)	(0.0909)	(0.0873)	(0.170)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	61	61	61	61	61	61	61
Adjusted R-squared	0.704	0.602	0.618	0.571	0.432	0.434	0.186

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Depreciation refers to the depreciation within each event window.

Table 11: June 24; Size of CAR, Losers Only

	(1) (-1,0)	(2) (-1,+1)	(3) (-1,+2)	(4) (-1,+3)	(5) (-1,+4)	(6) (-1,+14)	(7) (-1,+19)
Share of UK Affiliates	-0.0949***	-0.135***	-0.115***	-0.118***	-0.132***	-0.131***	-0.182***
	(0.0168)	(0.0257)	(0.0247)	(0.0259)	(0.0298)	(0.0307)	(0.0299)
Share of EU Affiliates	-0.0797***	-0.113***	-0.0964***	-0.112***	-0.123***	-0.118***	-0.108**
	(0.0237)	(0.0382)	(0.0366)	(0.0395)	(0.0459)	(0.0445)	(0.0462)
Depreciation	0.489	0.467	0.539	0.512	0.525	0.450	0.175
	(0.304)	(0.365)	(0.448)	(0.467)	(0.463)	(0.373)	(0.400)
Market Capitalization	-0.00230	0.00265	0.00565	0.00435	9.79e-05	0.000184	-0.00452
	(0.00464)	(0.00736)	(0.00801)	(0.00810)	(0.00967)	(0.00963)	(0.00897)
Number of Affiliates	-0.00364	-0.00307	-0.00576	-0.00627	-0.00699	-0.00649	-0.00588
	(0.00436)	(0.00733)	(0.00823)	(0.00816)	(0.00968)	(0.00911)	(0.00886)
Constant	0.0459	0.000581	-0.00875	0.0205	0.0649	0.0652	0.136**
	(0.0351)	(0.0548)	(0.0577)	(0.0573)	(0.0654)	(0.0644)	(0.0660)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	278	278	278	278	278	278	278
Adjusted R-squared	0.372	0.394	0.323	0.320	0.311	0.310	0.310

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Depreciation refers to the depreciation within each event window.

firms with greater UK or EU shares did better relative to expectation. By the end of that week, however, the coefficients are generally insignificant. This should not be interpreted as firms lacking ARs after 27 June; indeed Table 2 shows that some did. Instead, these estimates mean that a firm's AR was no longer significantly correlated with the GVC characteristics we control for.

Table 12 tells us two things. First, it says that the market altered its GVC-driven expectations primarily within the first two days of trading post-referendum, with those expectations very quickly moving to their new equilibrium level. Further indications of this are found by examining the adjusted R-squareds, where we see that the GVC-based reaction is mostly felt on 24 and 27 June. Second, it shows that the market did not fully reverse itself, i.e. it did not suffer from exuberant pessimism. To recognize this, consider the pattern of coefficients for the share variables. While they were significantly negative on 24 and 27 June, they were significantly positive on 28 June, albeit smaller in magnitude. After that they were insignificant. This means that on the first two trading days, firms heavily invested in Europe did worse than expectations. Although such firms did slightly better on the third day, suggesting some overshooting, this recovery was not enough to reverse the cumulative effect (as seen in the CAR results in Table 8). After that, such firms did no better or worse on average compared to their expected returns. Taken together the results of Table 12 suggests that the market revised its expectations in line with our hypotheses, did so quickly, and found little reason to reverse its overall negative assessment of firms whose GVCs are in particular danger because of Brexit.

Table 12: Daily Abnormal Returns after 23 June

	(1) June 23	(2) June 24	(3) June 27	(4) June 28	(5) June 29	(6) June 30
Share of UK Affiliates	-0.00106	-0.101***	-0.0556***	0.0170*	-0.0139	-0.00439
	(0.00594)	(0.0220)	(0.0184)	(0.00949)	(0.0104)	(0.00841)
Share of EU Affiliates	-0.00765**	-0.103***	-0.0576***	0.0212***	0.00190	-0.00602
	(0.00385)	(0.0163)	(0.0135)	(0.00745)	(0.00938)	(0.00689)
Depreciation	-0.0959	0.592*	0.159	-0.0117	-0.152	0.0739
	(0.0583)	(0.328)	(0.200)	(0.127)	(0.153)	(0.0914)
Market Capitalization	0.00248***	-0.0116**	-0.00465	-0.000263	-0.000103	-0.00128
	(0.000697)	(0.00489)	(0.00392)	(0.00176)	(0.00186)	(0.00164)
Number of Affiliates	-0.00442***	0.0104**	0.0111***	-0.000185	-0.000238	-0.00193
	(0.000737)	(0.00453)	(0.00347)	(0.00159)	(0.00154)	(0.00155)
Constant	0.0353***	-0.00854	-0.0590**	0.00579	0.0218	0.0286*
	(0.00794)	(0.0359)	(0.0286)	(0.0156)	(0.0169)	(0.0146)
Sector FE	YES	YES	YES	YES	YES	YES
Observations	339	339	339	339	339	339
Adjusted R-squared	0.163	0.461	0.348	0.169	0.077	0.080

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Depreciation refers to the depreciation within each event window.

3.3 The Importance of Imported Intermediates

In Hypothesis 2, we acknowledged that a decline in the Sterling can have conflicting effects on firm value since it simultaneously makes exporting more profitable and importing more

costly. This may be the reason for the lack of significance of the deprecation variable in the bulk of the estimates to this point. As a method of trying to separate out these two effects, in Table 13 we explore Hypothesis 3 by introducing the forwards and backwards participation indices, both on their own and interacted with the depreciation variable.[42] Introducing these additional terms does not greatly alter the coefficients for the previous control variables with the exception of the depreciation variable itself. Now, the positive coefficient is significant with the exception of the longest event window.

Turning to the new variables, neither of the forward linkage controls are significant. As this measures the share of exports that are intermediates, this is not surprising since a weaker Pound makes exporting both inputs and final goods easier. The backwards measures, however, are significant for most of the event windows. In particular, we find that the interaction is significantly negative in line with Hypothesis 3 which anticipated that the greater the importance of imported intermediates, the more damaging a depreciation would be. Thus, the positive non-interacted depreciation variable provides evidence consistent with the export-driven effect while its interaction with the backwards linkage measure provides results suggestive of the import-driven story. This then points towards conflicting effects that may help to explain the insignificance of the deprecation variable in the baseline results. Based on the estimates in column (1), an estimated zero net impact from deprecation at a backwards participation level of 1.262, meaning that 111 firms would see the CAR fall on net from a higher depreciation.

3.4 Robustness Checks

Building from our baseline results, in this section we undertake several robustness checks. First, in the baseline results, we used the EC industry classifications (see Table 6) because many of the 2-digit NACE classifications had few firms within them meaning that when using NACE dummies, those firms add little usable variation to our estimation. Rather than throw out the information they provided, we instead employed the coarser EC industry categories. Nevertheless, in Table 14, we replace the EC sector dummies with 2-digit NACE dummies and repeat our baseline estimation. As can be seen, the results are comparable to those in Table 8. Furthermore, the depreciation variable is now positive and significant as in Table 13. Note that despite using 63 industry groups rather than 13, the adjusted R-squared does not dramatically improve relative to the baseline estimates. With these similarities in mind, we do not use this as our baseline both because of the lack of within category variation and because other robustness checks required bootstrapping the errors and there was insufficient variation within NACE industries to do so. In any case, these results provide some reassurance that our findings are driven by within-industry firm-level heterogeneity rather than the simple cross-industry differences documented by Ramiah, Pham, and Moosa (2017).[43]

Our second robustness check addresses the potential concern that our results arise because firms with particular GVCs may simply have "noiser" returns, i.e. that firms with heavily

[42]Note that the participation measures are at a finer level of disaggregation than the sector dummies and we now cluster our robust standard errors at this lower level of aggregation. When attempting to do so when using 2-digit NACE industry categories, there was insufficient within-industry variation to permit clustering. This is one reason we use the EC classification in our baseline. That said, the non-clustered NACE version of Table 13 can be found in the Appendix, where we show that we get a positive significant result for depreciation and a typically negative, if insignificant, coefficient for the backwards interaction. In unreported results, we also interacted these with the two share variables. The results, however, were not significant. As another alternative, we omitted the forward participation variables and include only the backwards measures, but this

Table 13: June 24; Size of CAR, Interactions with Participation

	(1) (-1,0)	(2) (-1,+1)	(3) (-1,+2)	(4) (-1,+3)	(5) (-1,+4)	(6) (-1,+14)	(7) (-1,+19)
Share of UK Affiliates	-0.106***	-0.158***	-0.134***	-0.138***	-0.150***	-0.199***	-0.176***
	(0.0142)	(0.0224)	(0.0225)	(0.0239)	(0.0253)	(0.0270)	(0.0293)
Share of EU Affiliates	-0.105***	-0.157***	-0.140***	-0.164***	-0.174***	-0.164***	-0.138**
	(0.0258)	(0.0373)	(0.0371)	(0.0404)	(0.0447)	(0.0545)	(0.0548)
Depreciation	1.317**	1.295*	1.375*	1.649**	1.719***	1.043*	0.828
	(0.519)	(0.642)	(0.695)	(0.641)	(0.613)	(0.535)	(0.562)
Forwards	-0.00577	-0.00717	-0.00326	-0.00485	-0.00108	-0.00328	-0.00217
	(0.00480)	(0.00738)	(0.00702)	(0.00556)	(0.00642)	(0.00608)	(0.00693)
Forwards*Depreciation	0.0368	0.0431	0.0132	0.0431	-0.0117	0.0501	0.0445
	(0.0899)	(0.0997)	(0.102)	(0.0969)	(0.0926)	(0.0818)	(0.0945)
Backwards	0.0712***	0.100**	0.0857**	0.103***	0.111***	0.0929**	0.0729*
	(0.0240)	(0.0404)	(0.0398)	(0.0285)	(0.0333)	(0.0348)	(0.0371)
Backwards*Depreciation	-1.043***	-1.016**	-0.910*	-1.295***	-1.167***	-0.908**	-0.584
	(0.382)	(0.475)	(0.512)	(0.407)	(0.405)	(0.386)	(0.422)
Market Capitalization	0.00495	0.0152**	0.0156**	0.0163**	0.0149*	0.0103	0.00723
	(0.00370)	(0.00640)	(0.00584)	(0.00697)	(0.00861)	(0.00871)	(0.00768)
Number of Affiliates	-0.00746**	-0.0113*	-0.0124**	-0.0132**	-0.0147**	-0.0167**	-0.0136*
	(0.00331)	(0.00567)	(0.00520)	(0.00590)	(0.00706)	(0.00772)	(0.00687)
Constant	-0.0357	-0.131**	-0.128**	-0.123**	-0.122*	-0.0247	-0.0205
	(0.0331)	(0.0553)	(0.0565)	(0.0540)	(0.0631)	(0.0629)	(0.0592)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	339	339	339	339	339	339	339
Adjusted R-squared	0.458	0.456	0.413	0.419	0.401	0.426	0.383

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Depreciation refers to the depreciation within each event window.

Table 14: June 24; Using 2-Digit NACE Dummies

	(1) (-1,0)	(2) (-1,+1)	(3) (-1,+2)	(4) (-1,+3)	(5) (-1,+4)	(6) (-1,+14)	(7) (-1,+19)
Share of UK Affiliates	-0.0871***	-0.117***	-0.103***	-0.113***	-0.118***	-0.122***	-0.137***
	(0.0151)	(0.0263)	(0.0246)	(0.0251)	(0.0293)	(0.0301)	(0.0313)
Share of EU Affiliates	-0.0768***	-0.106***	-0.0955***	-0.119***	-0.126***	-0.120***	-0.112**
	(0.0215)	(0.0374)	(0.0342)	(0.0369)	(0.0444)	(0.0430)	(0.0443)
Depreciation	0.522	0.774*	0.893*	0.848	0.897	0.704	0.833*
	(0.367)	(0.444)	(0.525)	(0.552)	(0.560)	(0.461)	(0.475)
Market Capitalization	0.00568	0.0162*	0.0161*	0.0156	0.0144	0.0142	0.00734
	(0.00549)	(0.00914)	(0.00939)	(0.00953)	(0.0115)	(0.0113)	(0.0101)
Number of Affiliates	-0.00990*	-0.0166*	-0.0177*	-0.0182*	-0.0199*	-0.0185*	-0.0178*
	(0.00553)	(0.00940)	(0.00992)	(0.00980)	(0.0118)	(0.0111)	(0.0105)
Constant	0.0294	-0.0215	-0.0380	-0.0517	-0.0511	-0.0416	-0.0472
	(0.0504)	(0.0825)	(0.0845)	(0.0854)	(0.103)	(0.0993)	(0.0955)
NACE Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	339	339	339	339	339	339	339
Adjusted R-squared	0.476	0.475	0.417	0.425	0.396	0.393	0.416

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Depreciation refers to the depreciation within each event window. Sectors are 2-digit NACE codes.

Table 15: June 24; Size of CAR, Return Variance

	(1) (-1,0)	(2) (-1,+1)	(3) (-1,+2)	(4) (-1,+3)	(5) (-1,+4)	(6) (-1,+14)	(7) (-1,+19)
Share of UK Affiliates	-0.107***	-0.160***	-0.136***	-0.140***	-0.153***	-0.154***	-0.180***
	(0.0146)	(0.0244)	(0.0228)	(0.0225)	(0.0267)	(0.0269)	(0.0300)
Share of EU Affiliates	-0.0986***	-0.150***	-0.135***	-0.157***	-0.169***	-0.164***	-0.137***
	(0.0209)	(0.0322)	(0.0300)	(0.0320)	(0.0375)	(0.0371)	(0.0417)
Depreciation	0.473	0.494	0.586	0.595	0.630	0.522	0.442
	(0.309)	(0.371)	(0.441)	(0.465)	(0.446)	(0.381)	(0.395)
Market Capitalization	0.00541	0.0158**	0.0163**	0.0170**	0.0160*	0.0159*	0.00743
	(0.00406)	(0.00679)	(0.00687)	(0.00696)	(0.00837)	(0.00855)	(0.00761)
Number of Affiliates	-0.00875**	-0.0130*	-0.0140*	-0.0151*	-0.0169*	-0.0161*	-0.0153*
	(0.00442)	(0.00747)	(0.00797)	(0.00774)	(0.00903)	(0.00880)	(0.00846)
Return Variance	-0.0422	0.0476	0.0948	0.0970	0.131	0.133	-0.0475
	(0.189)	(0.288)	(0.314)	(0.343)	(0.328)	(0.312)	(0.365)
Constant	0.0299	-0.0278	-0.0288	-0.0145	0.00788	0.0109	0.0899
	(0.0330)	(0.0519)	(0.0539)	(0.0543)	(0.0637)	(0.0638)	(0.0653)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	339	339	339	339	339	339	339
Adjusted R-squared	0.433	0.438	0.396	0.397	0.377	0.376	0.365

Bootstrapped robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Depreciation refers to the depreciation within each event window.

European structures are simply prone to extreme changes in their returns. With this in mind, in Table 15 we introduce the estimated standard deviation of the firm's return as an additional control: *Return Variance*. As this control variable is constructed, here, we bootstrap our errors 1000 times. As can be seen, this measure is insignificant and does not affect our other results.[44] Therefore, it does not seem to be the case that our results are driven by "noisy" firms. Building on this idea of "noisy" firms, in further estimations, we alternatively employed Cook's distance estimator to examine the influence of outliers.[45] As can be found in the Appendix, this resulted in very similar estimates to those reported indicating that outliers are not driving the results.

Our third set of robustness checks deals with subsets of our firms. Here, given that Ramiah, Pham, and Moosa (2017) identify the Financial sector as one with many ARs, we omitted firms in this sector and re-estimated the baseline results, finding comparable estimates to our baseline. Next, we examined whether our results were driven by the 58 entirely British firms (i.e. those without any non-UK affiliates) by omitting them. When doing so, our results remain although the significance of the size variables declines somewhat. To construct a third subsample of the data, we omitted the 14 firms with a non-British GUO. Again, this had no impact of the findings. Finally, we omitted the largest firms based on market capitalization from our analysis over concerns that their CAR estimates may be biased due to endogeneity

did not alter the qualitative findings. These further estimates are available on request.

[43]When using NACE dummies including the interactions of Table 13, we find a positive and significant depreciation coefficient and an often negative, albeit insignificant, interaction between it and the backwards participation variable. These results are in the Appendix.

[44]Note that as we bootstrap our errors here, even though this is not required simply because our dependent variable is constructed, doing so has little impact on the significance of our other controls.

[45]See Chatterjee and Hadi (1988) for discussion.

(i.e. that their large returns drive the weighted-average based market return used when estimating CARs, creating outliers in the CAR data). Again, this does not alter our baseline findings. All of these alternative results are in the Appendix.

For the final robustness check discussed here, we turn from the British FTSE 350 to the German HDAX, which covers 110 of the largest firms traded on the Frankfurt Stock Exchange.[46] For these firms, we repeated the process we used for the FTSE 350, that is, for the 94 firms we could match to Orbis data, we constructed their returns, estimated their CARs, and then regressed these on the same set of firm-specific variables.[47] Comparable to the FTSE 350, the HDAX fell following the referendum (with a market return of -6.3% on 24 June and -3.3% on 27 June with a recovery thereafter; see the Appendix for details). In this sample of firms, however, there are two important differences compared to the British firms. First, they are far less heavily invested in the UK. Whereas the average UK affiliate share was 55% in the FTSE data, in the HDAX data it is only 3.9%. Even more telling is that 31 of our 94 firms have no British holdings at all, with half having less than 2.7% of their affiliates in the UK. Therefore we expect that the ability of the UK affiliate share to explain the CAR to be fairly small. Second, since Brexit affects dealings between the UK and the rest of the EU rather than between the remaining member states, Brexit should have little impact on dealings between German firms and their non-British EU affiliates. Therefore, unlike in the FTSE, we do not expect any role for the EU affiliate share in determining the CAR.

Table 16 presents our results for the CARs over the same estimation windows as our baseline British results. As can be seen, firm CARs are not significantly correlated with our firm characteristics. This is much as one might expect given the small exposure of these firms to the UK and the fact that Brexit has no obvious implications for trade between remaining EU members. This is not to say that these firms had no abnormal returns; as reported in the Appendix the number of significant abnormal returns spiked following the referendum with half of the HDAX firms having a significant AR on 27 June. Instead, this insignificance means that as expected our firm characteristics do not have much explanatory power for this alternative set of firms.

[46] This is the successor to the DAX 100.

[47] Summary statistics for these firms, including their CARs, can be found in the Appendix. Note that market capitalization here is logged thousands of Euros.

Table 16: June 24; DAX Results

	(1) (-1,0)	(2) (-1,+1)	(3) (-1,+2)	(4) (-1,+3)	(5) (-1,+4)	(6) (-1,+14)	(7) (-1,+19)
Share of UK Affiliates	-0.0295	-0.0745	-0.0378	-0.135	-0.181	-0.198	-0.0684
	(0.0591)	(0.0879)	(0.103)	(0.124)	(0.135)	(0.157)	(0.199)
Share of EU Affiliates	0.00232	0.0167	0.0128	-0.00375	-0.0246	-0.0157	-0.0447
	(0.0163)	(0.0270)	(0.0251)	(0.0321)	(0.0316)	(0.0383)	(0.0509)
Depreciation	0.209	0.605	1.191	0.403	0.243	-1.374	-1.799
	(0.770)	(0.839)	(0.817)	(1.139)	(1.151)	(0.994)	(1.666)
Market Capitalization	0.000358	0.00932**	0.00865**	0.0116**	0.0118**	0.0130**	0.0126*
	(0.00248)	(0.00354)	(0.00392)	(0.00474)	(0.00554)	(0.00623)	(0.00730)
Number of Affiliates	-9.35e-05	0.000170	-0.00202	-0.00386	-0.00588	0.000177	-0.00263
	(0.00232)	(0.00303)	(0.00335)	(0.00387)	(0.00406)	(0.00396)	(0.00511)
Constant	0.00249	-0.147***	-0.124**	-0.143**	-0.111	-0.167*	-0.126
	(0.0376)	(0.0512)	(0.0556)	(0.0700)	(0.0853)	(0.0948)	(0.108)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	94	94	94	94	94	94	94
Adjusted R-squared	-0.000	0.079	0.119	0.153	0.187	0.139	0.147

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Depreciation refers to the depreciation within each event window.

4 Additional Events

Although the above analysis focused on the Brexit referendum, that vote represented just the beginning of the Brexit process. With that in mind, in this section we repeat our procedure for five additional Brexit-related events.[48] The first is 5 October 2016, when British Prime Minister Theresa May spoke at the Conservative Party's convention and laid out her vision for what the Brexit negotiations would look like, including her plan to trigger Article 50 of the Treaty of Lisbon by the end of March 2017. The second was 3 November 2016, which is when a case challenging the legality of Brexit without Parliamentary approval was forwarded to the Supreme Court. The third event was May's 17 January 2017 speech wherein she committed to a "hard Brexit" including statements such as "I want to be clear. What I am proposing cannot mean membership of the Single Market."[49] The fourth was the announcement of the Supreme Court's decision that Parliament must be allowed to vote on whether to proceed with Brexit, an announcement which occurred on 24 January 2017. Fifth, we consider the impact of the 29 March 2017 invocation of Article 50 which began the two-year negotiation period before the UK officially leaves the EU.[50] Although these dates are not randomly chosen, these subsequent events can be thought of as quasi-placebo tests (see below for two actual placebo events).

Relative to the referendum, which as noted above was arguably unexpected, these subsequent events may have been more anticipated. For example, the 17 January speech was leaked beforehand with *The Telegraph* publishing key aspects the day prior to the speech.[51]

[48] Note that in unreported results using earlier start dates than the results reported here (i.e. where estimation windows are identical to the referendum's), we found few differences relative to the reported estimates.

[49] The full speech can be found in May (2017).

[50] Note that one of our 339 firms was delisted prior to this date, hence for this event we use 338 firms.

[51] See Dominiczak (2017).

Table 17: Additional events; AR

	05-Oct-16			03-Nov-16		
Date	Mean	St. Dev.	# with AR	Mean	St. Dev.	# with AR
t-4	-0.53%	2.43%	27	0.16%	1.48%	16
t-3	0.2%	1.37%	10	0.09%	1.42%	12
t-2	0.15%	1.69%	13	0.48%	1.68%	22
t-1	-0.42%	1.56%	13	0.61%	1.64%	17
t	-0.05%	1.74%	24	0.74%	5.1%	62
t+1	-0.11%	1.25%	17	-0.36%	5.7%	21
t+2	-0.95%	4.19%	69	-0.36%	5.7%	15
t+3	-0.91%	2.65%	19	-0.46%	1.6%	8
t+4	0.82%	1.97%	30	-0.43%	1.24%	65

Source: Own calculations based on Yahoo Finance data (2017).

Table 18: Additional events; AR

	17-Jan-17			24-Jan-17			29-Mar-17		
Date	Mean	St. Dev.	# with AR	Mean	St. Dev.	# with AR	Mean	St. Dev.	# with AR
t-4	-0.27%	1.91%	14	-0.15%	2.12%	10	-0.32%	1.28%	10
t-3	-0.25%	1.88%	20	0.24%	1.57%	14	0.50%	1.54%	34
t-2	-0.10%	1.49%	6	-0.11%	1.53%	12	-0.18%	1.66%	28
t-1	-0.05%	1.09%	5	0.53%	1.45%	12	-0.12%	1.13%	11
t	1.02%	2.04%	56	-0.04%	2.05%	16	-0.15%	1.10%	8
t+1	-0.15%	2.11%	9	-0.11%	1.62%	14	0.21%	1.40%	13
t+2	0.22%	1.57%	14	0.04%	1.60%	18	0.44%	2.29%	42
t+3	-0.12%	1.53%	13	-0.17%	1.60%	8	0.19%	2.53%	11
t+4	0.51%	1.44%	13	0.53%	1.46%	12	-0.06%	1.93%	14

Source: Own calculations based on Yahoo Finance data (2017).

Similarly, the actual date of the Article 50 triggering was announced more than a week beforehand. Thus, these events may not have caused as much of a market reaction if investors anticipated the results prior to the announcements. In addition, it is not clear how much new useful information was revealed during these events. Indeed, as of this writing, a charitable description of the Brexit negotiation process would be to call it uncertain, with slogans such as "Brexit means Brexit" providing little in the way of useful information to which investors can respond. Looking at Table 17 and Table 18 we see little reaction for three events (where each event occurs on date t in the table): 5 October, 24 January, and 29 March. For 3 November and 17 January, although there is a jump in the number of significant ARs on the day of the event, that number is small compared to the referendum itself. Further, even there the average size of the AR is small. Thus, the market reaction surrounding the various events was relatively muted.

In Tables 19 to 23 we undertake CAR analyses for the five additional events which are analogous to those for the referendum in Table 8. As can be seen, there are relatively few significant coefficients. Furthermore, the point estimates and adjusted R-squareds are noticeably smaller, suggesting that our GVC variables have little to say about the gap between actual and expected returns during these subsequent events. This gives further support to our assertion that investors altered their GVC-based expectations about firm's prospects primarily in the first few days after the announcement of the referendum's passing. One interesting

item to note is that for the two events challenging the legality of Brexit (3 November and 24 January), in contrast to the referendum, the estimated variables are generally of the opposite sign of those in Table 8 even though they are only occasionally significant. Since these two events might have led investors to hope that Brexit would not occur, this is in line with our overall expectations.

Table 19: October 5 (Speech on Negotiations); Size of CAR

	(1) (-1,0)	(2) (-1,+1)	(3) (-1,+2)	(4) (-1,+3)	(5) (-1,+4)	(6) (-1,+14)	(7) (-1,+19)
Share of UK Affiliates	-0.00248	-0.00120	-0.0337***	-0.0491***	-0.0376***	-0.0265	-0.00546
	(0.00544)	(0.00764)	(0.00931)	(0.0105)	(0.0116)	(0.0199)	(0.0223)
Share of EU Affiliates	0.0132	0.0186	0.00546	-0.00467	0.000971	-0.00367	-0.00120
	(0.0104)	(0.0119)	(0.0139)	(0.0159)	(0.0163)	(0.0265)	(0.0330)
Depreciation	-0.635	-0.157	-0.706	-0.210	0.0786	0.274	0.645
	(1.403)	(0.943)	(0.488)	(0.389)	(0.322)	(0.522)	(0.622)
Market Capitalization	-0.000724	-0.00141	0.000229	0.00137	-0.00248	0.00503	0.00624
	(0.00128)	(0.00170)	(0.00192)	(0.00216)	(0.00227)	(0.00601)	(0.00665)
Number of Affiliates	0.00199**	0.00309**	0.000901	0.000975	0.000463	-0.000415	0.00257
	(0.000932)	(0.00156)	(0.00284)	(0.00231)	(0.00238)	(0.00603)	(0.00615)
Constant	-0.000304	-0.00229	0.0219	0.00687	0.0265	-0.122*	-0.185**
	(0.0119)	(0.0153)	(0.0217)	(0.0217)	(0.0234)	(0.0695)	(0.0779)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	339	339	339	339	339	339	339
Adjusted R-squared	0.073	0.078	0.089	0.245	0.124	0.014	0.009

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Depreciation refers to the depreciation within each event window.

In addition to these five Brexit-related events, we considered two true placebos: 24 May 2016 and 6 February 2017 (the authors' name days/birthdays). Neither day saw a change in the pattern of ARs either before or after the event, i.e. the market did not seem to notice that we became another year older. When treating 24 May as an event, we found that the affiliate share variables were significantly positively correlated with the CARs, but that the magnitudes were very small. Using 6 February as an event, we found that our explanatory variables had no predictive power for the CAR sizes. Thus, these two placebos alongside the above Brexit-related events provide further support to the result that the GVC-driven response was concentrated around the Brexit referendum. Full results for these placebos are found in the Appendix.

Table 20: November 3 (Challenge of Brexit); Size of CAR

	(1) (-1,0)	(2) (-1,+1)	(3) (-1,+2)	(4) (-1,+3)	(5) (-1,+4)	(6) (-1,+14)	(7) (-1,+19)
Share of UK Affiliates	0.0178*	0.0226	0.00973	0.00181	-0.0146	0.0221	0.0601
	(0.00920)	(0.0170)	(0.0126)	(0.0121)	(0.0128)	(0.0256)	(0.0389)
Share of EU Affiliates	0.0116	0.0225	0.0114	-0.000334	-0.0181	0.0959**	0.107**
	(0.0188)	(0.0208)	(0.0206)	(0.0209)	(0.0235)	(0.0400)	(0.0521)
Depreciation	0.497	0.626	0.680**	0.612**	0.920**	1.357***	0.0630
	(0.523)	(1.374)	(0.277)	(0.263)	(0.403)	(0.448)	(0.884)
Market Capitalization	-0.00544***	-0.00775**	-0.00839***	-0.00584**	-0.00597**	-0.0171***	-0.0136*
	(0.00195)	(0.00300)	(0.00270)	(0.00265)	(0.00294)	(0.00582)	(0.00815)
Number of Affiliates	0.00262	0.00926*	0.0102*	0.00937*	0.00965*	0.0218***	0.0179*
	(0.00195)	(0.00524)	(0.00601)	(0.00564)	(0.00560)	(0.00705)	(0.00986)
Constant	0.0486**	0.0235	0.0306	0.0102	0.0511*	0.0867*	0.000173
	(0.0205)	(0.0362)	(0.0232)	(0.0225)	(0.0269)	(0.0486)	(0.0848)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	339	339	339	339	339	339	339
Adjusted R-squared	0.001	-0.004	-0.020	-0.025	-0.011	0.036	-0.019

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Depreciation refers to the depreciation within each event window.

Table 21: January 17 (Hard Brexit Speech); Size of CAR

	(1) (-1,0)	(2) (-1,+1)	(3) (-1,+2)	(4) (-1,+3)	(5) (-1,+4)	(6) (-1,+14)	(7) (-1,+19)
Share of UK Affiliates	0.0114**	0.00779	0.0112	0.0127	0.0179	0.0291*	0.0198
	(0.00512)	(0.00780)	(0.00862)	(0.0105)	(0.0120)	(0.0152)	(0.0186)
Share of EU Affiliates	0.0147**	0.0145	0.0139	0.0202	0.0262*	0.0372	0.0389
	(0.00710)	(0.00974)	(0.0103)	(0.0131)	(0.0151)	(0.0249)	(0.0340)
Depreciation	0.558*	0.262	0.174	0.180	0.234	0.413	0.810
	(0.318)	(0.380)	(0.418)	(0.578)	(0.415)	(0.714)	(0.632)
Market Capitalization	-0.000988	-0.000594	-0.00191	-0.00315*	-0.00396**	-0.00721**	-0.0105**
	(0.00112)	(0.00106)	(0.00129)	(0.00163)	(0.00199)	(0.00365)	(0.00469)
Number of Affiliates	0.00141	-0.00158	-0.00108	0.000196	0.000597	0.000319	0.00286
	(0.00143)	(0.00125)	(0.00148)	(0.00202)	(0.00221)	(0.00299)	(0.00393)
Constant	0.00872	0.0168	0.0219	0.0171	0.0199	0.0739**	0.126***
	(0.0100)	(0.0106)	(0.0133)	(0.0161)	(0.0186)	(0.0355)	(0.0447)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	339	339	339	339	339	339	339
Adjusted R-squared	0.103	0.049	0.038	0.020	0.048	0.011	0.010

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Depreciation refers to the depreciation within each event window.

Table 22: January 24 (Supreme Court Ruling); Size of CAR

	(1) (-1,0)	(2) (-1,+1)	(3) (-1,+2)	(4) (-1,+3)	(5) (-1,+4)	(6) (-1,+14)	(7) (-1,+19)
Share of UK Affiliates	0.00218	0.00171	0.000242	0.00796	0.0186**	0.0224	0.0231
	(0.00472)	(0.00644)	(0.00736)	(0.00741)	(0.00802)	(0.0147)	(0.0224)
Share of EU Affiliates	0.00399	0.0207*	0.0179	0.0167	0.0236	0.0296	0.00924
	(0.00971)	(0.0117)	(0.0142)	(0.0139)	(0.0157)	(0.0378)	(0.0403)
Depreciation	0.302	1.490*	0.885	0.832	0.816	1.456	0.541
	(1.325)	(0.807)	(0.785)	(1.214)	(1.245)	(1.366)	(1.664)
Market Capitalization	-0.00308*	-0.00274	-0.00326	-0.000630	-0.00113	-0.00743*	-0.00309
	(0.00167)	(0.00187)	(0.00217)	(0.00226)	(0.00230)	(0.00408)	(0.00441)
Number of Affiliates	0.000545	0.00321**	0.00300*	0.00209	0.000742	0.00113	-0.00178
	(0.000859)	(0.00154)	(0.00161)	(0.00154)	(0.00157)	(0.00266)	(0.00320)
Constant	0.0283	0.0178	0.0229	-0.00320	0.00402	0.0915**	0.0782*
	(0.0182)	(0.0212)	(0.0232)	(0.0243)	(0.0259)	(0.0360)	(0.0434)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	339	339	339	339	339	339	339
Adjusted R-squared	0.100	0.052	0.028	0.002	-0.001	0.000	0.008

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Depreciation refers to the depreciation within each event window.

Table 23: March 29 (Article 50); Size of CAR

	(1) (-1,0)	(2) (-1,+1)	(3) (-1,+2)	(4) (-1,+3)	(5) (-1,+4)	(6) (-1,+14)	(7) (-1,+19)
Share of UK Affiliates	-0.0139**	-0.0133**	-0.00306	-0.00561	-0.00615	0.0164	0.0124
	(0.00573)	(0.00631)	(0.00706)	(0.00857)	(0.00981)	(0.0321)	(0.0385)
Share of EU Affiliates	-0.0134	-0.00414	-0.00988	-0.0234	-0.0138	0.00869	0.0181
	(0.00886)	(0.0123)	(0.0150)	(0.0197)	(0.0191)	(0.0219)	(0.0289)
Depreciation	-0.703	0.485	0.403	0.230	0.263	0.318	-0.0140
	(0.601)	(0.595)	(0.654)	(0.589)	(0.722)	(0.920)	(1.060)
Market Capitalization	-0.00109	-0.00253**	-0.00239	-0.00213	-0.00280	-0.00453	-0.00426
	(0.000834)	(0.00109)	(0.00157)	(0.00199)	(0.00193)	(0.00389)	(0.00470)
Number of Affiliates	0.00107*	0.000868	0.00111	-0.000122	-0.000748	-0.00152	0.00578
	(0.000622)	(0.000796)	(0.00150)	(0.00200)	(0.00167)	(0.00307)	(0.00612)
Constant	0.0119	0.0227**	0.0167	0.0203	0.0288*	0.0460	0.00640
	(0.00888)	(0.0107)	(0.0134)	(0.0147)	(0.0163)	(0.0524)	(0.0657)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	338	338	338	338	338	338	338
Adjusted R-squared	0.051	0.133	0.009	0.011	0.020	0.040	0.021

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Depreciation refers to the depreciation within each event window.

5 Conclusion

The UK's decision to leave the European Union has created concerns about its social, political, and economic repercussions. However, as of this writing, the UK has not yet left the EU and therefore there is a need for policy makers to develop expectations on what may happen in order to prepare. While some studies, such as Dhingra, et al. (2016a) use computable general equilibrium analysis to generate predictions, we instead analyze the expectations embodied in stock market price movements. Using data from the FTSE 350, we show two key things.

The first key result is that the market's reaction is consistent with investors responding to the potential impacts on a firm's global value chain. We see this in several ways. First, we find that firms with GVCs heavily oriented towards Europe perform worse than the market as a whole. Second, because the depreciation of the Sterling is expected to encourage exports but hamper imports, we find that the effect of the fall in the Pound is contingent on the importance of a firm's imported intermediates. Third, firms with more complex global networks (measured by the number of affiliates) did worse compared to others. Finally, larger firms seem like they are expected to ride out the turmoil of Brexit more easily than the average firm. These insights into the importance of within-industry heterogeneity then adds to the work of Schiereck, Kiesel, and Kolaric (2016) and Ramiah, Pham, and Moosa (2017) and extends it in several important directions.

The second key result is that the market's reaction was swift and long-lasting, with the bulk of the changes being capitalized into market prices in the first two trading days following the announcement of the referendum's result. Despite the quick reaction, the changes detailed above persisted over time, meaning that the initial relative losses of vulnerable GVC firms were not reversed even as the market recovered. Furthermore, we find little reaction to subsequent Brexit-related events including the actual triggering of Article 50. This sure-footed reaction on the part of investors gives some indication of their confidence in their expectations for what Brexit means for GVCs.

Note that although we focus our discussion on the impact of Brexit on trade, it can affect other aspects of the firm's global structure. Dhingra, et al. (2016b) posit the effect of Brexit on FDI, suggesting that it will lead to a 22% decline over the next decade, resulting in income losses of between 1.8% and 4.3%. Head and Mayer (2015) estimate the effect of Brexit on plant location as well as the level of production and prices in the car industry in different countries. Depending on the scenario, consumer surplus falls between 2.9% and 4.9%, while the impact on the car production in the UK varies between an increase of 0.4% to a decrease of 12.2%. Thus, although we frame our discussion as indicative of Brexit's effect on trade patterns, it is likely that some of the impacts are the result of investors' expectations for altered FDI patterns as well.

In any case, our estimates give an alternative approach to the development of expectations of what Brexit will mean, an approach which complements the simulation approach used elsewhere. While it is clear that investors are worried on average, the evidence points to different expectations for different firms. Recognizing which firms are anticipated to be hit the hardest by the challenges of Brexit – and thus the workers they employ and the regions in which they operate – gives the governments of both the UK and its trading parters the ability to begin to tailor policy to mitigate the effects on such vulnerable groups.

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A Appendix

Here we present some of additional results referred to in the main body of the paper.

In our main results, we use the SUR methodology of estimating CARs. One alternative is the "residual method" in which the estimation window is used to estimate $R_{i\tau} = \alpha_i + \beta_i R_{m\tau} + \varepsilon_{i\tau}$, the estimated coefficients from which are then used to calculate the AR as $\widehat{AR}_{it} = R_{it} - (\widehat{\alpha}_i + \widehat{\beta}_i R_{mt})$. Table A1 presents the baseline results using these alternative CARs. As can be seen, the results are comparable with the exception that the depreciation variable is now generally significant at the 10% level.

As noted in the paper, we do not use the affiliate share weighted depreciation due to colinearity with the UK share variable. Table A2 presents the correlation between the two affiliate share variables and the affiliate share weighted depreciation. The results of the baseline estimation when replacing the depreciation variable in the text with this weighted version are found in Table A3. As expected, introducing this colinear variable wipes out the significance of the UK share and reduces the significance of the other variables. Nevertheless, the overall pattern in terms of coefficient signs remains, even for the UK share.

Although we do not use the NACE two-digit industry dummies for the reasons discussed in the paper, it is useful to see how their inclusion affects the results when also including the forward and backwards linkages interactions (as no NACE category has multiple values of the participation variables, we do not include them on their own). These estimates are found in Table A4. As in the main body of the paper, when including these interactions the depreciation variable is significantly positive. The interaction with the backwards linkages, however, is insignificant in all the event windows. Given the small variation in this across firms within a 2-digit NACE category, this is not unexpected.

One method of dealing with outliers is to employ the robust regression methodology of Chatterjee and Hadi (1988). When doing so in Table A5, we see that our results hold.

Several robustness checks employ subsets of the data. Table A6 omits the firms in the Financial and Insurance Sector. Table A7 uses only those firms which have affiliates outside the UK. Table A8 omits the firms where the global ultimate owner is not British. Finally, Table A9 leaves out the largest firms. As can be seen, although the decline in the number of observations has some impact on significance in some of the results, the overall findings are robust.

Table A10 presents information on the daily ARs surrounding the Brexit referendum for the HDAX firms in the first three columns, around our first placebo of 24 May 2016 in the next three, and our second placebo of 6 February 2017 in the final three. For the HDAX, we find a downturn in the market and a spike in the number of ARs primarily on 27 June, the second day of trading after the result of the voting was announced. For our two placebos, there is no noticeable shift in ARs around these non-events. Finally, Tables A11 and A12 regress the CARs from the placebos on the controls. For 24 May, when the estimated coefficients are significant, they are much smaller and the opposite sign from what is found in the baseline. For 6 February, only one coefficient is significant and then only marginally so.

Table A1: June 24; Size of CAR using Residual Method for CAR Construction

	(1) (-1,0)	(2) (-1,+1)	(3) (-1,+2)	(4) (-1,+3)	(5) (-1,+4)	(6) (-1,+14)	(7) (-1,+19)
Share of UK Affiliates	-0.104***	-0.156***	-0.133***	-0.129***	-0.132***	-0.133***	-0.150***
	(0.0153)	(0.0255)	(0.0238)	(0.0236)	(0.0262)	(0.0262)	(0.0282)
Share of EU Affiliates	-0.0933***	-0.138***	-0.124***	-0.134***	-0.137***	-0.132***	-0.100**
	(0.0205)	(0.0344)	(0.0313)	(0.0326)	(0.0365)	(0.0359)	(0.0389)
Depreciation	0.635**	0.736*	0.836*	0.816*	0.832*	0.698*	0.557
	(0.308)	(0.385)	(0.439)	(0.460)	(0.445)	(0.370)	(0.382)
Market Capitalization	0.00777*	0.0209***	0.0205***	0.0204***	0.0195**	0.0195**	0.00926
	(0.00419)	(0.00704)	(0.00692)	(0.00686)	(0.00799)	(0.00794)	(0.00694)
Number of Affiliates	-0.0116**	-0.0189**	-0.0194**	-0.0199**	-0.0223**	-0.0214**	-0.0192**
	(0.00453)	(0.00789)	(0.00803)	(0.00787)	(0.00905)	(0.00863)	(0.00807)
Constant	0.00747	-0.0823	-0.0824	-0.0653	-0.0546	-0.0520	0.0634
	(0.0325)	(0.0527)	(0.0514)	(0.0499)	(0.0569)	(0.0557)	(0.0558)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	339	339	339	339	339	339	339
Adjusted R-squared	0.400	0.389	0.349	0.329	0.293	0.291	0.272

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Depreciation refers to the depreciation within each event window.

Table A2: Correlation Matrix between Affiliate Shares and Weighted Depreciations

	Share of UK Affiliates	Share of EU Affiliates
Deprec. (-1,0)	-0.9892	0.4038
Deprec. (-1,1)	-0.9847	0.4048
Deprec. (-1,2)	-0.9879	0.413
Deprec. (-1,3)	-0.9881	0.4029
Deprec. (-1,4)	-0.9923	0.4149
Deprec. (-1,14)	-0.9907	0.3948
Deprec. (-1,19)	-0.9874	0.3785

Depreciation refers to the affiliate-share weighted depreciation within each event window.

Table A3: June 24; Size of CAR, Weighted Depreciation

	(1) (-1,0)	(2) (-1,+1)	(3) (-1,+2)	(4) (-1,+3)	(5) (-1,+4)	(6) (-1,+14)	(7) (-1,+19)
Share of UK Affiliates	-0.0897	-0.140	-0.0893	-0.00863	0.0645	0.0851	-0.0920
	(0.0898)	(0.109)	(0.135)	(0.141)	(0.242)	(0.261)	(0.215)
Share of EU Affiliates	-0.0893***	-0.138***	-0.117***	-0.121**	-0.118*	-0.103	-0.107
	(0.0287)	(0.0419)	(0.0434)	(0.0493)	(0.0658)	(0.0782)	(0.0756)
Depreciation	0.499	0.470	0.846	1.962	2.694	2.705	1.103
	(1.149)	(0.992)	(1.351)	(1.554)	(2.419)	(2.432)	(1.954)
Market Capitalization	0.00458	0.0145**	0.0148**	0.0157**	0.0144*	0.0142*	0.00641
	(0.00381)	(0.00629)	(0.00619)	(0.00646)	(0.00763)	(0.00775)	(0.00715)
Number of Affiliates	-0.00554*	-0.00850	-0.00921*	-0.0108*	-0.0118*	-0.0117*	-0.0113*
	(0.00325)	(0.00559)	(0.00543)	(0.00559)	(0.00642)	(0.00647)	(0.00626)
Constant	0.0175	-0.0371	-0.0638	-0.135	-0.194	-0.209	0.00931
	(0.0891)	(0.100)	(0.119)	(0.121)	(0.215)	(0.230)	(0.199)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	339	339	339	339	339	339	339
Adjusted R-squared	0.428	0.434	0.391	0.397	0.376	0.376	0.364

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Depreciation refers to the affiliate-share weighted depreciation within each event window.

Table A4: June 24; Size of CAR, Interactions with Participation and NACE classifications

	(1) (-1,0)	(2) (-1,+1)	(3) (-1,+2)	(4) (-1,+3)	(5) (-1,+4)	(6) (-1,+14)	(7) (-1,+19)
Share of UK Affiliates	-0.0873***	-0.117***	-0.102***	-0.113***	-0.117***	-0.158***	-0.134***
	(0.0133)	(0.0209)	(0.0235)	(0.0281)	(0.0266)	(0.0227)	(0.0260)
Share of EU Affiliates	-0.0781***	-0.106***	-0.0946**	-0.120***	-0.126***	-0.120**	-0.107*
	(0.0241)	(0.0369)	(0.0355)	(0.0409)	(0.0457)	(0.0537)	(0.0556)
Depreciation	0.810***	0.955***	1.020**	1.080**	1.115**	0.662*	0.850**
	(0.277)	(0.346)	(0.446)	(0.496)	(0.472)	(0.370)	(0.400)
Forwards*Depreciation	-0.0789**	-0.0572	-0.0521	-0.0728	-0.0777	-0.0477	-0.0550
	(0.0333)	(0.0363)	(0.0373)	(0.0443)	(0.0478)	(0.0500)	(0.0533)
Backwards*Depreciation	-0.0569	-0.0127	0.0275	-0.0191	0.00899	0.0395	0.160
	(0.0881)	(0.109)	(0.124)	(0.141)	(0.134)	(0.121)	(0.126)
Market Capitalization	0.00468	0.0153*	0.0155**	0.0147	0.0134	0.00753	0.00713
	(0.00501)	(0.00837)	(0.00761)	(0.00934)	(0.0119)	(0.0115)	(0.0106)
Number of Affiliates	-0.00916**	-0.0158**	-0.0170***	-0.0174***	-0.0189**	-0.0174**	-0.0171**
	(0.00394)	(0.00625)	(0.00547)	(0.00641)	(0.00800)	(0.00801)	(0.00737)
Constant	0.0326	-0.0180	-0.0349	-0.0481	-0.0464	0.0630	-0.0424
	(0.0409)	(0.0693)	(0.0632)	(0.0771)	(0.0956)	(0.0955)	(0.0875)
NACE Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	339	339	339	339	339	339	339
Adjusted R-squared	0.482	0.474	0.415	0.424	0.395	0.454	0.416

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Depreciation refers to the depreciation within each event window. Sectors are 2-digit NACE codes.

Table A5: June 24; Size of CAR, Robust Regression Estimator

	(1) (-1,0)	(2) (-1,+1)	(3) (-1,+2)	(4) (-1,+3)	(5) (-1,+4)	(6) (-1,+14)	(7) (-1,+19)
Share of UK Affiliates	-0.108***	-0.164***	-0.148***	-0.153***	-0.164***	-0.167***	-0.196***
	(0.0141)	(0.0220)	(0.0197)	(0.0221)	(0.0244)	(0.0247)	(0.0269)
Share of EU Affiliates	-0.0998***	-0.150***	-0.135***	-0.157***	-0.174***	-0.171***	-0.143***
	(0.0189)	(0.0296)	(0.0265)	(0.0291)	(0.0323)	(0.0322)	(0.0352)
Depreciation	0.419*	0.393	0.260	0.268	0.350	0.250	0.432
	(0.225)	(0.259)	(0.257)	(0.321)	(0.309)	(0.272)	(0.313)
Market Capitalization	0.00807***	0.0203***	0.0185***	0.0199***	0.0195***	0.0193***	0.0117**
	(0.00285)	(0.00446)	(0.00399)	(0.00438)	(0.00486)	(0.00486)	(0.00530)
Number of Affiliates	-0.0110***	-0.0186***	-0.0164***	-0.0168***	-0.0186***	-0.0178***	-0.0215***
	(0.00263)	(0.00412)	(0.00371)	(0.00408)	(0.00454)	(0.00441)	(0.00492)
Constant	0.0215	-0.0276	-0.00480	-0.00219	0.0156	0.0211	0.0888*
	(0.0288)	(0.0448)	(0.0401)	(0.0442)	(0.0491)	(0.0489)	(0.0536)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	339	339	339	339	339	339	339
Adjusted R-squared	0.476	0.505	0.492	0.453	0.453	0.452	0.432

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Depreciation refers to the depreciation within each event window.

Table A6: June 24; Size of CAR, Omitting Financial Sector Firms

	(1) (-1,0)	(2) (-1,+1)	(3) (-1,+2)	(4) (-1,+3)	(5) (-1,+4)	(6) (-1,+14)	(7) (-1,+19)
Share of UK Affiliates	-0.119***	-0.179***	-0.160***	-0.166***	-0.185***	-0.186***	-0.217***
	(0.0178)	(0.0257)	(0.0233)	(0.0257)	(0.0294)	(0.0286)	(0.0354)
Share of EU Affiliates	-0.120***	-0.185***	-0.175***	-0.206***	-0.224***	-0.220***	-0.197***
	(0.0223)	(0.0343)	(0.0303)	(0.0341)	(0.0384)	(0.0381)	(0.0438)
Depreciation	0.689**	0.587	0.630	0.718	0.714	0.619	0.394
	(0.329)	(0.368)	(0.413)	(0.467)	(0.456)	(0.381)	(0.419)
Market Capitalization	0.0101***	0.0245***	0.0245***	0.0279***	0.0295***	0.0292***	0.0214***
	(0.00345)	(0.00545)	(0.00491)	(0.00519)	(0.00598)	(0.00587)	(0.00627)
Number of Affiliates	-0.00926**	-0.0117*	-0.0141**	-0.0167**	-0.0204***	-0.0197***	-0.0204**
	(0.00397)	(0.00673)	(0.00647)	(0.00675)	(0.00757)	(0.00715)	(0.00826)
Constant	-0.0143	-0.102**	-0.0844*	-0.0873*	-0.0737	-0.0691	0.0227
	(0.0321)	(0.0472)	(0.0454)	(0.0490)	(0.0551)	(0.0527)	(0.0631)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	251	251	251	251	251	251	251
Adjusted R-squared	0.552	0.590	0.561	0.544	0.529	0.529	0.468

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Depreciation refers to the depreciation within each event window.

Table A7: June 24; Size of CAR, Only Firms not 100% UK

	(1) (-1,0)	(2) (-1,+1)	(3) (-1,+2)	(4) (-1,+3)	(5) (-1,+4)	(6) (-1,+14)	(7) (-1,+19)
Share of UK Affiliates	-0.102***	-0.162***	-0.139***	-0.144***	-0.156***	-0.160***	-0.182***
	(0.0152)	(0.0243)	(0.0224)	(0.0229)	(0.0261)	(0.0254)	(0.0314)
Share of EU Affiliates	-0.0905***	-0.145***	-0.128***	-0.153***	-0.165***	-0.162***	-0.130***
	(0.0209)	(0.0341)	(0.0315)	(0.0348)	(0.0400)	(0.0396)	(0.0438)
Depreciation	1.080**	0.763	0.815	0.656	0.684	0.428	0.424
	(0.473)	(0.512)	(0.540)	(0.583)	(0.602)	(0.399)	(0.576)
Market Capitalization	0.00259	0.0107	0.0104	0.0122	0.0116	0.0116	0.00411
	(0.00478)	(0.00787)	(0.00797)	(0.00866)	(0.0105)	(0.0105)	(0.00955)
Number of Affiliates	-0.00527	-0.00703	-0.00783	-0.0102	-0.0119	-0.0108	-0.0123
	(0.00558)	(0.00933)	(0.00953)	(0.0103)	(0.0126)	(0.0120)	(0.0116)
Constant	-0.00534	-0.0363	-0.0262	0.000285	0.0190	0.0338	0.103
	(0.0399)	(0.0596)	(0.0563)	(0.0576)	(0.0707)	(0.0618)	(0.0751)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	281	281	281	281	281	281	281
Adjusted R-squared	0.426	0.439	0.405	0.383	0.348	0.347	0.329

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Depreciation refers to the depreciation within each event window.

Table A8: June 24; Size of CAR, Firms with British Owner

	(1) (-1,0)	(2) (-1,+1)	(3) (-1,+2)	(4) (-1,+3)	(5) (-1,+4)	(6) (-1,+14)	(7) (-1,+19)
Share of UK Affiliates	-0.110***	-0.162***	-0.138***	-0.144***	-0.158***	-0.158***	-0.181***
	(0.0149)	(0.0242)	(0.0223)	(0.0228)	(0.0265)	(0.0266)	(0.0307)
Share of EU Affiliates	-0.0957***	-0.148***	-0.130***	-0.148***	-0.159***	-0.154***	-0.120***
	(0.0204)	(0.0319)	(0.0307)	(0.0338)	(0.0394)	(0.0376)	(0.0459)
Depreciation	0.453	0.485	0.575	0.543	0.565	0.474	0.383
	(0.321)	(0.385)	(0.451)	(0.475)	(0.478)	(0.384)	(0.421)
Market Capitalization	0.00488	0.0149**	0.0159**	0.0162**	0.0150*	0.0149*	0.00704
	(0.00423)	(0.00708)	(0.00714)	(0.00729)	(0.00876)	(0.00865)	(0.00793)
Number of Affiliates	-0.00849*	-0.0127	-0.0139*	-0.0146*	-0.0163*	-0.0157*	-0.0143
	(0.00461)	(0.00784)	(0.00821)	(0.00823)	(0.00980)	(0.00921)	(0.00885)
Constant	0.0335	-0.0203	-0.0249	-0.00511	0.0207	0.0228	0.0888
	(0.0333)	(0.0547)	(0.0549)	(0.0545)	(0.0646)	(0.0622)	(0.0667)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	325	325	325	325	325	325	325
Adjusted R-squared	0.434	0.438	0.395	0.398	0.376	0.376	0.361

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Depreciation refers to the depreciation within each event window.

Table A9: June 24; Size of CAR, Omitting Largest Firms

	(1) (-1,0)	(2) (-1,+1)	(3) (-1,+2)	(4) (-1,+3)	(5) (-1,+4)	(6) (-1,+14)	(7) (-1,+19)
Share of UK Affiliates	-0.107***	-0.160***	-0.137***	-0.141***	-0.153***	-0.155***	-0.180***
	(0.015)	(0.0237)	(0.0219)	(0.0226)	(0.0259)	(0.0261)	(0.0298)
Share of EU Affiliates	-0.097***	-0.147***	-0.133***	-0.155***	-0.165***	-0.160***	-0.138***
	(0.021)	(0.0331)	(0.0308)	(0.0337)	(0.0389)	(0.0377)	(0.0419)
Depreciation	0.477	0.496	0.588	0.606	0.642	0.516	0.463
	(0.312)	(0.377)	(0.442)	(0.463)	(0.462)	(0.378)	(0.408)
Market Capitalization	0.003	0.0109	0.0122	0.0130	0.0104	0.0103	0.004
	(0.005)	(0.00823)	(0.00831)	(0.00858)	(0.0103)	(0.0102)	(0.009)
Number of Affiliates	-0.009*	-0.0128*	-0.0139*	-0.0150*	-0.0167*	-0.0158*	-0.015*
	(0.004)	(0.00759)	(0.00797)	(0.008)	(0.010)	(0.009)	(0.009)
Constant	0.046	0.00402	-0.00165	0.0128	0.0469	0.0506	0.109
	(0.038)	(0.0608)	(0.0614)	(0.0614)	(0.0723)	(0.0707)	(0.0727)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	328	328	328	328	328	328	328
Adjusted R-squared	0.417	0.412	0.369	0.371	0.354	0.353	0.352

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Depreciation refers to the depreciation within each event window.

Table A10: DAX and Placebo events; AR

	DAX			24-May-16			06-Feb-17		
Date	Mean	St. Dev.	# with AR	Mean	St. Dev.	# with AR	Mean	St. Dev.	# with AR
t-4	1.45%	1.48%	14	0.12%	1.62%	25	0.47%	1.4%	7
t-3	-1.16%	1.54%	4	0.4%	1.76%	22	0.29%	1.61%	10
t-2	0.55%	1.13%	3	-0.09%	1.47%	13	-0.31%	1.23%	11
t-1	-0.84%	1.24%	25	0.58%	1.27%	18	0.08%	1.59%	15
t	1.22%	2.36%	23	-0.22%	1.69%	33	0.07%	1.04%	2
t+1	-3.07%	2.53%	53	-0.21%	2.46%	34	0%	0%	20
t+2	0.52%	1.88%	8	0.05%	2.21%	19	0.51%	1.76%	24
t+3	0.74%	1.61%	10	-0.24%	3.41%	38	0.31%	1.49%	7
t+4	-0.07%	1.76%	8	0.13%	1.91%	18	-0.3%	1.35%	14

Source: Own calculations based on Yahoo Finance data (2017).

Table A11: May 24 2016; Size of CAR, Placebo Test

	(1) (-1,0)	(2) (-1,+1)	(3) (-1,+2)	(4) (-1,+3)	(5) (-1,+4)	(6) (-1,+14)	(7) (-1,+19)
Share of UK Affiliates	0.00832	0.0150*	0.000237	0.0402***	0.0552***	-0.0469***	-0.0106
	(0.00527)	(0.00898)	(0.00667)	(0.0150)	(0.0168)	(0.0174)	(0.0176)
Share of EU Affiliates	0.0217***	0.0222*	0.00884	0.0497***	0.0630***	-0.0133	0.00772
	(0.00682)	(0.0134)	(0.00954)	(0.0170)	(0.0201)	(0.0260)	(0.0312)
Depreciation	1.162**	0.350	0.744	-0.355	4.901	-0.0820	0.664
	(0.456)	(0.548)	(0.561)	(0.888)	(3.149)	(0.557)	(0.617)
Market Capitalization	-5.94e-05	-0.00168	-0.00174	0.00166	0.00245	0.00491	0.00629
	(0.00123)	(0.00205)	(0.00144)	(0.00243)	(0.00233)	(0.00337)	(0.00398)
Number of Affiliates	0.00207	0.00423*	0.00224	0.00249	0.00278	-0.00463	-0.00108
	(0.00128)	(0.00256)	(0.00149)	(0.00260)	(0.00273)	(0.00287)	(0.00305)
Constant	0.00146	0.00116	0.0181	-0.0478**	-0.0642**	0.0170	-0.0226
	(0.00987)	(0.0176)	(0.0137)	(0.0236)	(0.0278)	(0.0421)	(0.0504)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	339	339	339	339	339	339	339
Adjusted R-squared	0.191	0.083	0.109	0.104	0.108	0.047	0.011

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Depreciation refers to the affiliate-share weighted depreciation within each event window.

Table A12: February 6 2017; Size of CAR, Placebo Test

	(1) (-1,0)	(2) (-1,+1)	(3) (-1,+2)	(4) (-1,+3)	(5) (-1,+4)	(6) (-1,+14)	(7) (-1,+19)
Share of UK Affiliates	-0.00675	-0.00100	0.00539	0.000814	-0.00781	0.0314*	0.00773
	(0.00885)	(0.00562)	(0.00552)	(0.00573)	(0.00708)	(0.0178)	(0.0199)
Share of EU Affiliates	-0.0124	-0.00580	-0.0125	-0.0173	-0.0179	-0.00897	-0.0426
	(0.00933)	(0.0122)	(0.0137)	(0.0151)	(0.0204)	(0.0343)	(0.0304)
Depreciation	0.204	-0.239	-1.063	-0.362	0.244	-0.128	-1.239
	(0.950)	(0.859)	(0.950)	(0.743)	(0.848)	(0.974)	(1.059)
Market Capitalization	-0.000150	-0.00184	-0.00127	-0.000112	-0.00197	0.00793	0.00490
	(0.000953)	(0.00120)	(0.00154)	(0.00175)	(0.00203)	(0.00546)	(0.00641)
Number of Affiliates	-0.00153*	-0.000312	-0.000221	-0.000500	-0.000733	-0.00333	-0.000447
	(0.000882)	(0.000869)	(0.00125)	(0.00142)	(0.00148)	(0.00347)	(0.00384)
Constant	0.0240*	0.0446***	0.0333**	0.0302*	0.0518**	-0.0154	0.0419
	(0.0127)	(0.0150)	(0.0163)	(0.0179)	(0.0201)	(0.0442)	(0.0483)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	339	339	339	339	339	339	339
Adjusted R-squared	0.070	0.024	0.072	0.087	0.040	0.053	0.030

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Depreciation refers to the affiliate-share weighted depreciation within each event window.