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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. Alternatively, we examine expectations embodied in stock returns using a two-part estimation process. While most firms' prices fell, there was considerable heterogeneity in their relative changes. We show that this heterogeneity can be explained by the firm's global value chain, with heavily European firms doing relatively worse. For firms with few imported intermediates, this was partially offset by a greater Sterling depreciation. These changes were primarily in the first two days and highly persistent. Understanding these movements gives a better understanding Brexit's potential effects.

JEL Classification: F15; F23; G14
Keywords: Global Value Chain; Event Study; Brexit

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1 Introduction

The UK's decision on 23 June 2016 to quit the European Union – "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 of significant trade barrier increases, a number of studies have used computable general equilibrium analysis to develop predictions for various alterations to trade barriers. 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.[1] Alternatively, if protection levels rise to 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 analysis obtain somewhat different predictions, the general expectation is that Brexit will have serious negative consequences for the UK and its major trading partners.[2] 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-part estimation process similar to Blonigen, Tomlin, and Wilson (2004) which combines an event study methodology for firms listed on the FTSE350 (the 350 largest firms on the London Stock Exchange) with a regression analysis. In the first stage, we compare a firm's actual return to its predicted return contingent on the performance of the overall market. The difference between the two, known as the abnormal return, can then be interpreted as embodying investors' expectations about a firm's future performance relative to the rest of the market. We then regress this on firm characteristics measuring the firm's global value chain (GVC) structure. This second stage indicates the extent to which a firm's relative performance following the Brexit referendum 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.[3] 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 14.4% smaller which, in the market model approach, can roughly be interpreted as a return that is 14.4% worse relative to the market.[4]

[1] 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.

[2] 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) finds 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.

[3] Head and Mayer (2015) describe three possible disadvantages of Brexit for 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 consumer after Brexit.

[4] Strictly speaking, this is a return that is 14.4% worse than expectations; since in the long run a firm's return should equal the market, results in our comparison. See below for a detailed discussion of how to

If that shift is instead to the EU (but not the UK), the firm does 12.9% worse relative to the market. This indicates 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 a 10% greater depreciation of the Sterling relative to the firm's other main currencies results in a 4.2% better performance compared to the market, suggesting that the export effect dominates. Expanding on this by using a difference-in-differences approach that employs information on the importance of imported intermediates across industries, we find that the effect does indeed vary along these lines, with firms heavily involved with importing intermediates having significantly smaller abnormal returns as the Sterling depreciation grows. Finally, we also find that larger firms fared better whereas those with more affiliates (and potentially more complex GVCs) performed worse relative to the average. This indicates that, even as the market as a whole fell, that 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 results' announcement).[5] However, by a week later (June 30) it and reached its former level. However, 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 where at-risk GVCs did markedly worse on the 24th and 27th but slightly better on 28 June. After that, however, they were treated no differently than other firms. 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 observed 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, those losses relative to the rest of the market remained.

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 case challenging the legality of Brexit to the High Court), 17 January 2017 (the "Hard Brexit" speech by Prime Minister May), 24 January 2017 (the High 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 aftermath of the referendum's outcome, the market reaction to these events was slight. 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

interpret changes in the abnormal return and how this motivates our nomenclature.

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

– was largely manifested in the two trading days after the announcement of the referendum's results.

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 largely 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. First, it fits in alongside event studies analyzing the impacts of trade policies. These studies generally examine the impact of sector-specific trade policies (often for the US) on the returns for in the effected 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 semi-conductor 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 and in particular use a two-part methodology as 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 the impact of the trucking industry provisions under NAFTA, finding that these effects differ between purely domestic

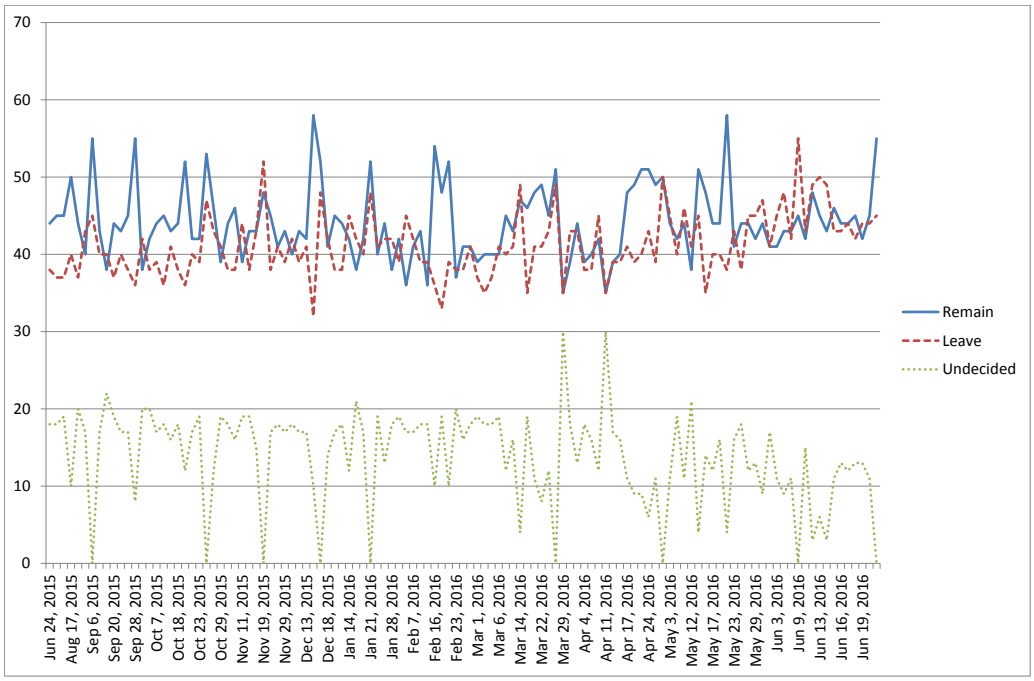
[6] See Irish Times (2017) for an entertaining discussion of the lengths brokerages were going to in order to be prepared as soon as markets opened.

[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



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.

One event study particularly relevant for our discussion 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, they do not consider *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.[10] 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. Finally, they only consider the Brexit vote; we however consider five subsequent Brexit-related events, finding that the Brexit vote was by far the one that was most affecting. Thus, while their paper was an early analysis to identify various reactions in stock markets to Brexit, ours contributes by providing

[10]When using only sector-fixed effects in our baseline estimates, our regression results in an R-squared of .157; when also including our GVC controls, this rises to .400 indicating that a major part of the variation is firm-specific rather than industry-specific.

a framework for understanding the heterogeneous responses to Brexit.

Second, 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).[11] 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, as the surveys of Feestra (1989) and Amador and Cabral (2016) suggest, comparable to trade in final products, 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.[12]

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 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.

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 London Stock Exchange.[13] 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 London Stock Exchange's total value. The next 250 largest firms (the FTSE 250) make

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

[12] Davies, et al. (forthcoming) find that tariff pass-through within a multinational is roughly half that of an arm's length transaction.

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

up approximately 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 London Stock Exchange as of October 2016 and maintain this set of firms through all of our analysis.[14] This was then trimmed to 339 firms due to lack of firm-level GVC controls as explained below.

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. With this information, we then apply an event study methodology. The intuition of this approach is that, given the efficiency of the market, a firm's stock price should adjust so that on average it should yield a return equal to that of the market. During an "event", however, investors may shift expectations about this firm's future performance causing its actual return to differ from what one would predict given 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 the market as a whole.

To do this, one uses an "estimation window" prior to the event to develop the firm-specific prediction for its return given that of the market on a given trading day. While there are several approaches to estimating this "normal" return, we use the commonly used market model.[15] This model individually estimates, for each firm i, its return $R_{i\tau}$ as a function of the market's $R_{m\tau}$ for each trading day τ in the estimation window, i.e. it estimates

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

where $\varepsilon_{i\tau}$ is the mean zero, constant variance error term. As shown by MacKinlay (1997), this can be done via ordinary least squares (OLS) which is a consistent and efficient estimation procedure for the market model. 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.[16] The data on the market return for the FTSE 350 comes from Investing.com as Yahoo Finance did not have it available.[17]

With these estimated coefficients in hand, we then predict out-of-sample returns for each firm during the event, e.g. for for the period of time surrounding the Brexit referendum. Firm i's abnormal return (AR) on a date t during the event, $\widehat{AR}_{it}$, is then defined as its actual return minus its predicted value, i.e.

$$\widehat{AR}_{it} = R_{it} - (\widehat{\alpha}_i + \widehat{\beta}_i R_{mt}) \tag{2}$$

where $\widehat{\alpha}_i$ and $\widehat{\beta}_i$ are the parameters obtained from estimating (1). In other words, the AR on this date is the residual from the out-of-sample prediction with a positive AR indicating

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

[15] See MacKinlay (1997) for an overview of different estimation methods.

[16] 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.

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

that the firm's return is greater than expected given the overall market conditions and a negative AR indicating the opposite. Since under the market model a firm's return should equal that of the overall market on average, we use this to describe whether a firm does better (positive AR) or worse (negative AR) relative to the market as a whole. This nomenclature has two important aspects. First, a decline in the AR means that the difference between the actual and predicted value decreases. This does not mean, however, that the prediction becomes more accurate. If the firm starts with a positive AR that then moves towards zero, the decline in the AR does indeed mean that the prediction is closer to the actual return. However, if the firm starts with a negative AR and the AR falls (becomes more negative), then the gap between the actual and predicted values grows. Thus, to measure the accuracy of the prediction, it is necessary to focus on the absolute value of the AR which is not what we use. Second, since the AR measures relative performance, interpreting a decline in the AR as a change in relative performance again depends on whether the AR is positive of negative. If the AR is negative, a smaller (more negative) AR means the firm does even worse compared to the market. On the other hand, if the AR is initially positive, a fall in the AR can mean the firm still does better relative to the market (i.e. a positive albeit smaller AR) or now does worse (if the AR switches from positive to negative). With all of this in mind, to minimize clumsy exposition, we will use the terms "smaller AR" and "doing worse relative to the market" interchangeably while implicitly acknowledging these more nuanced interpretations.

Table 1 reports the ARs for the days leading up to the June 23 referendum and shortly thereafter. 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.[18] This is important as, in line with our assertions above, it indicates that 24 June can properly be viewed as an "event" meaning that investors did not significantly change their behavior until the results were announced. 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 slightly elevated, indicative of some continuing turbulence in the market.

In addition to the daily AR, one can examine the cumulative abnormal return (CAR) which is the sum of ARs across 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 price over the two 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 the rest of the market even if there is a partial correction.

Beyond the size of the AR or the CAR, the researcher is also often interested in the significance of it, i.e. whether the residual is sufficiently large relative to the typical noise in a firm's day-to-day return so as to label it a significantly abnormal return. Under the null hypothesis that the event has no impact on the properties of the returns, the abnormal

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

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%	1.70%	-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	-3.80%	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).

returns are normally distributed with a zero mean and a variance of

$$\sigma^2(\widehat{AR}_{it}) = \sigma^2_{\varepsilon_i} + \frac{1}{L_1}\left[1 + \frac{(R_{mt} - \widehat{\mu}_m)^2}{\widehat{\sigma}^2_m}\right] \tag{3}$$

where L_1 is the length of the estimation window, R_{mt} is the market return on date t, $\widehat{\mu}_m$ is the mean of the market return during the estimation window, $\widehat{\sigma}^2_m$ its variance, and $\sigma^2_{\varepsilon_i}$ the variance of the error term in equation (1).

The conditional variance in equation (3) has two components: $\sigma^2_{\varepsilon_i}$ and the additional variance due to the sampling error in estimating $\widehat{\alpha}_i$ and $\widehat{\beta}_i$. However, as the length of the estimation window becomes large (150 days in our case), the sampling error tends towards zero. Hence, the variance of the abnormal return will converge to the variance of the market model $\sigma^2_{\varepsilon_i}$, and the abnormal return observations will become independent through time. In other words we can estimate the variance of the abnormal returns by replacing $\sigma^2_{\varepsilon_i}$ with the variance of the estimation residuals $\widehat{\sigma}^2_{\varepsilon_i}$. Hence, the distribution of the sample abnormal return of a given observation in the event window is $AR_{it} \backsim N(0, (\sigma^2(\widehat{AR}_{it}))$.

As a consequence, to investigate the statistical significance of the abnormal return one can implement a t-test with the underlying null hypothesis that there are no abnormal returns during the event period. This test statistic is given by:

$$z_{it} = \frac{\widehat{AR}_{it}}{\sigma(\widehat{AR}_{it})} \tag{4}$$

where $\sigma^2(\widehat{AR}_{it}) \cong \sigma^2_{\varepsilon_i}$.

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 the market would have suggested) and those that were significantly negative (i.e. those who did significantly worse than expected, even accounting for the overall fall in the market). This again shows the very swift – and significant – reaction of the market. In the four days prior to the announcement of the referendums results, there

were on average 27 significant ARs per day. In contrast, on the two days after the results came out, there were eight times as many significant ARs (with the large share being significantly negative). After those days, 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.

Table 2: Significant ARs Surrounding the 23 June Referendum

Date	Total Significant ARs	Positive AR	Negative AR
20-June-16	61	53	8
21-June-16	17	11	6
22-June-16	13	6	7
23-June-16	17	13	4
24-June-16	216	58	158
27-June-16	205	32	173
28-June-16	79	69	10
29-June-16	64	45	19
30-June-16	57	32	25
14-July-16	28	19	9
21-July-16	19	9	10

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

Note that while a significantly positive AR indicates that a firm did better than expected, it is still possible that its return was negative since a positive AR simply means that it did better than one would have expected relative to the overall fall in the market. On 24 June, 61 of our 339 firms did see their stock prices rise (a positive return). By definition, 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 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.

2.2 Firm Controls

Our main goal is then 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 in intermediates, 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. 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.[19] For each GUO,

[19]Of the remainder, 7 GUOs were in Ireland, 3 in Bermuda, and 1 each in Canada, Germany, Spain, and

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).[20] 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 3. Note that the mean number of affiliates is 176 affiliates, a number driven in part by a firm with 3,393 affiliates worldwide.[21] The median firm in our sample has 81 affiliates. Note that 58 of the firms are entirely UK-based. In unreported results we omitted those 58 firms and obtained comparable results.[22] 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 3: 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 (2016).

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 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 should fall (so that the firm does worse relative to the market). 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

the Cayman Islands. When restricting the sample to only British GUOs, the results were comparable to those reported in the paper.

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

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

[22] These firms are worth recognizing as for them, the depreciation of the Sterling measure we use was zero.

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. Thus, the net effect is ambiguous and depends on whether the import or export effect dominates.

To estimate this net effect, we construct a weighted average depreciation of the Sterling against other currencies where the weights are the share of the firm's affiliates in a given currency.[23] 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 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.*

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 value of exports of intermediates in total exports, and the backwards participation, which measures the value of imported inputs in the 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 for an industry with a large backwards participation should fare worse because this makes their relatively important imported intermediates more expensive. 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 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 number of affiliates. Given the results of Amiti, Itskhoki, and Konings (2014) and Davies, et al. (forthcoming), we might expect that larger firms are better able to ride out the waves generated by Brexit.[24] Thus, we expect that the larger the market capitalization, the better

[23]For example, if the firm has 25% of its affiliates in the UK, 25% in the US, and 50% in the EU, this would be calculated as 0*.25+7.8*.25+5.8*.5=4.85. 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.

[24]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.

a firm does relative to expectations. For the number of affiliates, however, this might be countered by the possibility that firms with many affiliates have more complex GVCs and may therefore be more vulnerable to the negative effects of Brexit. This leads to our final two hypotheses.

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

Hypothesis 5 *The more complex the firm's global value chain, as measured by the number of affiliates, the lower its abnormal return and the worse its relative performance.*

Data on market capitalization comes from Yahoo Finance (2017) and is measured as logged billions of Pounds. The number of affiliates comes from Orbis (2016) and is also measured in logs. Summary statistics on the depreciation between June 23 and 24, the forwards and backwards participations, and market capitalization are in Table 4.[25]

Table 4: 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

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 AR on 24 June using an ordered probit. Second is to estimate how the size of the AR and CAR is correlated with firm characteristics.

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). We therefore estimate

$$\begin{aligned} AR_i = f(&\beta_0 + \beta_1 UK_i + \beta_2 EU_i + \beta_3 Depreciation_i \\ &+\beta_4 MktCap_i + \beta_5 NumAff_i + \alpha_s) + \epsilon_i \end{aligned} \tag{5}$$

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 weighted depreciation of the Sterling, the firm's market capitalization, its number of affiliates, a vector of sector dummies, and an error term.

For the size estimations, we estimate a comparable linear regression

$$\begin{aligned} CAR_{i,t} = &\beta_0 + \beta_1 UK_i + \beta_2 EU_i + \beta_3 Depreciation_{i,t} \\ &+\beta_4 MktCap_i + \beta_5 NumAff_i + \alpha_s + \epsilon_i \end{aligned} \tag{6}$$

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

where the dependent variable is now the value of the CAR. In both, for our sector dummies, we use the broad classification scheme based on NACE codes which classifies firms as Manufacturing (73 firms), Services (144), Financial (88), Utilities/Construction (19), or Mining (15).[26] In the latter, where we estimate both the size of ARs and CARs across various windows, the subscript t denotes the date of the AR or the ending date of the CAR as appropriate. 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. 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.[27]

3.1 Significance of AR

In Table 5 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, means that none had significantly negative ARs) 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, 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 underperformed relative to market). For the UK share, this holds for both those with a positive return on the day and those that did not; the EU share, however, seems to be driven primarily from those firms which saw a decline in their share prices. 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 insignificant across all three specifications perhaps reflecting the conflicting effects it can have as indicated in Hypothesis 2. For the full sample, we find results consistent with Hypotheses 4 and 5, i.e. that larger firms and those with less complex GVCs are more likely to significantly outperform relative to expectations.

While these results indicate the direction of the significance of a AR, there is important information it does not address. In particular, it says nothing about the size of that AR, that is, how much better it did relative to expectations. This is the issue we address in in our subsequent regressions.

[26] In unreported results, we instead used 2 digit NACE sector dummies. When doing so, we obtained comparable results for the share variables in terms of magnitude and significance, however the depreciation and market capitalization measures were often insignificant. As many of our firms were the sole ones in these 2 digit categories, we have opted for these broader classification. In unreported results, given that Ramiah, Pham, and Moosa (2017) identify the Financial sector as one with many ARs, we omitted this sector. Results were comparable to those here and are available on request.

[27] Further, when using the industry-level participation measures, we also cluster by industry.

Table 5: Ordered Probit Estimates

	(1) All	(2) Gains	(3) Losses
Share of UK Affiliates	-2.172***	-1.761**	-2.106***
	(0.356)	(0.869)	(0.456)
	-1.151	*-0.511*	*-0.931*
Share of EU Affiliates	-1.666***	-2.365	-1.674***
	(0.452)	(1.548)	(0.526)
	-0.228	*-0.687*	*-0.181*
Depreciation	1.941	-19.29	4.393
	(6.044)	(20.91)	(6.607)
	0.089	*-5.600*	*0.152*
Market Capitalization	0.321***	0.257	0.120
	(0.0987)	(0.238)	(0.116)
	2.415	*0.074*	*0.689*
Number of Affiliates	-0.214**	0.0206	-0.141
	-0.857	*0.006*	*-0.441*
Cutoff between $\{0, 1\}$	1.444**		1.049
	(0.710)		(0.818)
Cutoff between $\{1, 2\}$	0.0319	-0.562	-0.873
	(0.682)	(2.590)	(0.824)
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.

3.2 Size of CAR

In Table 6, 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 a five trading days beginning with 24 June, then $t = 14$ in column (6), then $t = 19$ in column (7). 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 shifting 10% of a firm's affiliates from outside the EU or the UK into the UK would result in a 14.4% smaller CAR compared to the sample average, i.e. a return 14.4% lower than the overall market. For the median firm, this would imply a shift of 8 affiliates from outside Europe to the UK. Similarly, shifting them from outside Europe into the rest of the EU would result in a 12.9% lower CAR. 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, unlike the ordered probit estimates, we now find a significant effect which suggests that a larger depreciation of the Sterling is correlated with a higher CAR and a better relative performance. This effect, however, is less significant than those for the affiliate shares and is insignificant for our four week CAR in column (7), perhaps indicative of the conflicting nature of this variable. Using the estimate from column (1), this would suggest that a 10% larger depreciation would be associated with a 4.2% larger CAR. In light of Hypothesis 2, this suggests that the export aspect of the exchange rate movement is the dominant feature.

As for market capitalization, in all specifications excepting the longest event window we find a significantly positive effect suggesting that a 10% increase in the firm's size would result in a 0.08% larger CAR.[28] This is consistent with Hypothesis 4, albeit it indicates that the magnitude of the firm size effect is small. Similarly, although we find a significantly negative effect from the number of affiliates in line with Hypothesis 5, the estimated magnitude is small, with the coefficient in column (1) indicating that a 10% increase in the number of affiliates would me a CAR that is 0.12% lower.

Taken together, these estimates suggest four things. First, the CARs are not random, rather they are significantly correlated with firm characteristics. Thus, although the market declined overall, some firms did relatively better than others. 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, the subsequent correction in the market still results in a net expectation of declining firm value, something explored in more detail below. Finally, by examining the R-squareds

[28] In unreported results, we omitted the largest ten firms out of concern that these firms may drive the market return. When doing so, the only impact was that market capitalization was insignificant about half of the time.

Table 6: 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	-0.104***	-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.

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 again shows that the primary GVC-based market reactions were during the first two days of trading.

In Table 7 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 an 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 depreciation results which are somewhat less significant, the main results hold. Note that one reason for this possible reduction in the depreciation findings is that the depreciation is now measured relative to the day before the referendum, whereas in Table 6 it is measured against the 23 June value of the Pound.

One potential concern with our results is firms with particular GVCs may simply have "noiser" returns, i.e. that firms with heavily European structures are simply prone to extreme changes in their returns. With this in mind, in Table 8 we introduce the estimated standard deviation of the firm's return (Equation (3)) as an additional control *Return Variance*. As this control variable is constructed, here, we bootstrap our errors 1000 times. Although this is marginally significant in the two shortest event windows, where it suggests that firms with greater variance did better, this measure is insignificant in the other event windows. Further, comparing R-squareds between these results and those in the baseline, we find that adding this variable has little effect on our estimates.[29] Therefore, it does not seem to be the case that our results are driven by "noisy" firms.

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

Table 7: 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	-0.103***	-0.154***	-0.131***	-0.127***	-0.130***	-0.172***	-0.146***
	(0.0149)	(0.0250)	(0.0232)	(0.0233)	(0.0258)	(0.0271)	(0.0277)
Share of EU Affiliates	-0.0973***	-0.143***	-0.128***	-0.139***	-0.142***	-0.126***	-0.105***
	(0.0209)	(0.0349)	(0.0315)	(0.0329)	(0.0368)	(0.0368)	(0.0381)
Depreciation	0.555*	0.685*	0.785*	0.756	0.788*	0.412	0.539
	(0.324)	(0.398)	(0.455)	(0.483)	(0.463)	(0.355)	(0.397)
Market Capitalization	0.00764*	0.0208***	0.0204***	0.0203***	0.0194**	0.0124*	0.00922
	(0.00408)	(0.00693)	(0.00678)	(0.00674)	(0.00787)	(0.00730)	(0.00677)
Number of Affiliates	-0.00984**	-0.0172**	-0.0176**	-0.0181**	-0.0205**	-0.0205**	-0.0178**
	(0.00436)	(0.00771)	(0.00784)	(0.00770)	(0.00888)	(0.00804)	(0.00791)
Constant	0.00179	-0.0884*	-0.0885*	-0.0712	-0.0610	0.0568	0.0549
	(0.0330)	(0.0533)	(0.0516)	(0.0505)	(0.0575)	(0.0540)	(0.0550)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	339	339	339	339	339	339	339
Adjusted R-squared	0.367	0.374	0.334	0.309	0.274	0.316	0.257

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

Table 8: 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	-0.0987***	-0.146***	-0.127***	-0.127***	-0.128***	-0.129***	-0.145***
	(0.0156)	(0.0257)	(0.0252)	(0.0245)	(0.0282)	(0.0273)	(0.0302)
Share of EU Affiliates	-0.0882***	-0.129***	-0.118***	-0.133***	-0.134***	-0.128***	-0.0956**
	(0.0211)	(0.0345)	(0.0328)	(0.0334)	(0.0383)	(0.0384)	(0.0409)
Depreciation	0.647**	0.750**	0.843*	0.818*	0.835*	0.704*	0.558
	(0.299)	(0.378)	(0.430)	(0.463)	(0.435)	(0.372)	(0.377)
Market Capitalization	0.00891**	0.0231***	0.0217***	0.0208***	0.0203***	0.0203***	0.0103
	(0.00404)	(0.00693)	(0.00670)	(0.00668)	(0.00766)	(0.00770)	(0.00721)
Number of Affiliates	-0.0113**	-0.0183**	-0.0190**	-0.0198**	-0.0220**	-0.0212**	-0.0188**
	(0.00445)	(0.00775)	(0.00799)	(0.00778)	(0.00880)	(0.00862)	(0.00780)
Return Variance	0.532*	1.027*	0.561	0.177	0.370	0.392	0.500
	(0.297)	(0.524)	(0.465)	(0.462)	(0.649)	(0.622)	(0.784)
Constant	-0.0163	-0.128**	-0.107**	-0.0731	-0.0709	-0.0696	0.0417
	(0.0339)	(0.0588)	(0.0544)	(0.0538)	(0.0624)	(0.0628)	(0.0687)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	339	339	339	339	339	339	339
Adjusted R-squared	0.403	0.393	0.350	0.327	0.291	0.290	0.272

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

Table 9: 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	-0.0608***	-0.0772**	-0.0701**	-0.0676***	-0.0619**	-0.0635**	-0.0644**
	(0.0179)	(0.0320)	(0.0271)	(0.0253)	(0.0261)	(0.0275)	(0.0302)
Share of EU Affiliates	-0.118***	-0.140***	-0.131***	-0.0898**	-0.0728**	-0.0850***	-0.0633*
	(0.0311)	(0.0441)	(0.0340)	(0.0344)	(0.0316)	(0.0285)	(0.0338)
Depreciation	-0.145	0.0933	0.122	0.108	0.117	0.0876	0.128
	(0.367)	(0.511)	(0.453)	(0.390)	(0.367)	(0.352)	(0.377)
Market Capitalization	0.000663	0.00399	0.00648*	0.0110***	0.0138***	0.0202***	0.00380
	(0.00300)	(0.00694)	(0.00326)	(0.00333)	(0.00377)	(0.00439)	(0.00493)
Number of Affiliates	-0.00421	-0.0118**	-0.00979**	-0.0130***	-0.0180***	-0.0147***	-0.0153**
	(0.00287)	(0.00525)	(0.00424)	(0.00458)	(0.00518)	(0.00538)	(0.00677)
Constant	0.118***	0.158**	0.106***	0.0665**	0.0571	-0.0304	0.130**
	(0.0329)	(0.0781)	(0.0390)	(0.0323)	(0.0406)	(0.0447)	(0.0528)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	61	52	67	96	125	164	175
Adjusted R-squared	0.628	0.525	0.541	0.333	0.252	0.223	0.094

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

In Tables 9 and 10 we repeat the process of Table 6 for those firms that had a positive return on 24 June and those that did not (comparable to columns 2 and 3 of Table 5).[30] In both, we find negative coefficients for the UK and EU affiliate shares which, with the exception of the longest event window for the losers, are statistically significant. Although the point estimates for the UK share is higher for the losers in Table 10 we find the opposite ranking for the gainers in Table 9. However, in no case can we reject the null hypothesis of equally sized coefficients and the confidence intervals overlap across the subsets. Thus, the results point to the notion that regardless of whether a firm's stock price rose or fell the day after the referendum's results were announced, consistent with Hypothesis 1, it did worse relative to the overall market.

This does not mean that differences across the two groups of firms cannot be found. In particular, the depreciation variable is significantly related to the CAR only for the losers and then only for the shorter event windows. On the other hand, 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 factor for the CAR is the share of affiliates a firm has in the UK or the EU.

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 6 indicate that, even as the market as a whole regained its losses, not all firms did so equally. To explore the timing of the market's recovery, Table 11 presents estimates for the day-by-day AR, rather than the CAR over the event window.

As can be seen, on the first two trading days, 24 and 27 June, the results are comparable

[30] 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 10: 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	-0.0855***	-0.130***	-0.113***	-0.0898***	-0.0692**	-0.0787*	-0.0486
	(0.0175)	(0.0264)	(0.0245)	(0.0272)	(0.0327)	(0.0428)	(0.0364)
Share of EU Affiliates	-0.0720***	-0.106***	-0.0913**	-0.0750*	-0.0669	-0.112*	-0.0542
	(0.0226)	(0.0367)	(0.0359)	(0.0402)	(0.0485)	(0.0659)	(0.0597)
Depreciation	0.699**	0.751**	0.657	0.682	0.642	0.531	0.342
	(0.303)	(0.371)	(0.438)	(0.457)	(0.446)	(0.396)	(0.391)
Market Capitalization	0.000197	0.00984	0.00580	0.000791	-0.00970	-0.00735	-0.00750
	(0.00472)	(0.00771)	(0.00849)	(0.00875)	(0.0103)	(0.0111)	(0.00919)
Number of Affiliates	-0.00688	-0.0104	-0.00680	-0.00705	-0.00920	-0.00594	-0.00684
	(0.00448)	(0.00782)	(0.00843)	(0.00815)	(0.00899)	(0.0101)	(0.00817)
Constant	0.0173	-0.0718	-0.0528	-0.0403	0.0130	-0.0154	-0.0135
	(0.0360)	(0.0556)	(0.0587)	(0.0576)	(0.0635)	(0.0683)	(0.0636)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	278	287	272	241	214	175	164
Adjusted R-squared	0.327	0.327	0.262	0.180	0.161	0.158	0.074

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

to the baseline specification. After that, however, the coefficients are generally insignificant. This should not be interpreted as firms lacking ARs after 27 June and indeed Table 2 shows that there were. Instead, these estimates mean that a firm's AR was no longer significantly correlated with the GVC characteristics we control for. Even across the first two trading days, we see a pattern in which the firm's characteristics lose their explanatory power as the two share coefficients fall by half and the depreciation variable becomes insignificant.

This tells us two things. First, it says that the market altered its expectations depending on a firm's GVC within the first two days of trading. As such, expectations were very quickly altered to their new equilibrium level. In particular, examining the adjusted R-squareds, we see that the GVC-based reaction is mostly felt in the first two days of trading. 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 the overall market would suggest. Such firms did slightly better on the third day, suggesting some overshooting, but not by enough to reverse the cumulative effect (as seen in the CAR results in Table 6). After that, such firms did no better or worse on average compared to the rest of the market. Taken together the results of Table 11 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.

In Table 12 we explore Hypothesis 3 by introducing the forwards and backwards participation indices, both on their own and interacted with the depreciation variable.[31] Introducing

[31] 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. In unreported results, we also interacted these with the two share variables. The results, however, were not significant. As another alternative,

Table 11: Daily Abnormal Returns after 23 June

	(1) June 24	(2) June 27	(3) June 28	(4) June 29	(5) June 30	(6) July 14	(7) July 21
Share of UK Affiliates	-0.0972***	-0.0524***	0.0206***	0.00138	-0.00313	-0.00032	0.0128
	(0.0162)	(0.0134)	(0.00711)	(0.00897)	(0.00676)	(0.00541)	(0.00850)
Share of EU Affiliates	-0.0933***	-0.0450**	0.0163*	-0.0119	-0.00118	0.0173*	0.000545
	(0.0217)	(0.0180)	(0.00889)	(0.00979)	(0.00795)	(0.00902)	(0.0100)
Depreciation	0.731**	0.257	-0.0240	-0.154	0.120	0.0419	0.145*
	(0.309)	(0.193)	(0.116)	(0.139)	(0.0847)	(0.0523)	(0.0810)
Market Capitalization	0.0121***	0.0131***	-0.000406	-3.09e-05	-0.000950	-0.00012	-0.00274***
	(0.00437)	(0.00336)	(0.00151)	(0.00142)	(0.00148)	(0.000882)	(0.00101)
Number of Affiliates	-0.0140***	-0.00715*	4.26e-05	-0.000348	-0.00229	0.00068	0.00298*
	(0.00471)	(0.00378)	(0.00160)	(0.00169)	(0.00157)	(0.000944)	(0.00155)
Constant	-0.0279	-0.0895***	0.00297	0.0194	0.0110	-0.000310	-0.00141
	(0.0337)	(0.0271)	(0.0142)	(0.0162)	(0.0134)	(0.00891)	(0.0147)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	339	339	339	339	339	339	339
R-squared	0.415	0.286	0.165	0.064	0.029	0.063	0.083

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

these additional terms does not greatly alter the coefficients for the previous control variables. The forwards participation, either on its own or interacted with the depreciation, is not significant. This is perhaps not surprising as the role of exchange rates should be similar regardless of whether the exports are final goods or intermediates. The backwards measure, however, is 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. Our estimates indicate an estimated zero net impact from deprecation at a backwards participation level of 1.786. Based on this, 26 firms would see the AR fall on net from a higher depreciation. This then highlights the conflicting nature of the two trade impacts of exchange rate movements.

we omitted the forward participation variables and include only the backwards measures, but this did not alter the qualitative findings.

Table 12: 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	-0.103***	-0.152***	-0.128***	-0.125***	-0.127***	-0.172***	-0.145***
	(0.0145)	(0.0257)	(0.0252)	(0.0256)	(0.0265)	(0.0274)	(0.0282)
Share of EU Affiliates	-0.0964***	-0.142***	-0.125***	-0.137***	-0.139***	-0.129**	-0.102*
	(0.0248)	(0.0367)	(0.0352)	(0.0381)	(0.0409)	(0.0544)	(0.0516)
Depreciation	1.617**	1.791*	1.891*	2.096**	2.102**	1.349**	1.143*
	(0.690)	(0.895)	(0.949)	(0.867)	(0.809)	(0.624)	(0.649)
Forwards	-0.000365	0.00277	0.00580	0.00488	0.00921	0.00573	0.00710
	(0.00536)	(0.00852)	(0.00820)	(0.00644)	(0.00684)	(0.00622)	(0.00644)
Forwards*Depreciation	-0.0523	-0.0802	-0.110	-0.103	-0.141	-0.0464	-0.0549
	(0.0956)	(0.111)	(0.117)	(0.107)	(0.0960)	(0.0916)	(0.0951)
Backwards	0.0619**	0.0890*	0.0761	0.0874***	0.0912***	0.0724**	0.0494
	(0.0263)	(0.0468)	(0.0460)	(0.0308)	(0.0332)	(0.0290)	(0.0313)
Backwards*Depreciation	-0.957**	-0.947*	-0.853	-1.131**	-1.001**	-0.812**	-0.475
	(0.416)	(0.546)	(0.588)	(0.431)	(0.396)	(0.345)	(0.362)
Market Capitalization	0.00657	0.0193**	0.0191***	0.0189**	0.0178*	0.0114	0.00872
	(0.00411)	(0.00766)	(0.00704)	(0.00776)	(0.00924)	(0.00869)	(0.00785)
Number of Affiliates	-0.00994**	-0.0165**	-0.0172**	-0.0175**	-0.0196**	-0.0209**	-0.0182**
	(0.00400)	(0.00674)	(0.00658)	(0.00716)	(0.00831)	(0.00865)	(0.00839)
Constant	-0.0459	-0.172**	-0.170**	-0.158**	-0.162**	-0.0113	-0.000706
	(0.0432)	(0.0761)	(0.0738)	(0.0661)	(0.0743)	(0.0666)	(0.0643)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	339	339	339	339	339	339	339
Adjusted R-squared	0.423	0.407	0.369	0.354	0.324	0.343	0.282

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 consider five additional events. 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 High 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."[32] The fourth was the announcement of the High 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. Although these dates are not randomly chosen, these subsequent events can be thought of as quasi-placebo tests.

Relative to the referendum, which as noted above were 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.[33] 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. That said, looking at Table 13 and Table 14 we see that the market reaction surrounding the various events (each of which occurs on date t in the table) was rather muted, with few abnormal returns and average ARs that were no where near as large as those in the wake of the referendum.

In Tables 15 to 19 we undertake CAR analyses for the five additional events which are analogous to those for the referendum in Table 6.

As can be seen, there are relatively fewer significant coefficients. Furthermore, the point

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

[33] See Dominiczak (2017).

Table 13: 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%	11	0.16%	1.48%	11
t-3	0.20%	1.37%	2	0.10%	1.42%	8
t-2	0.15%	1.69%	7	0.48%	1.68%	13
t-1	-0.42%	1.56%	10	0.61%	1.64%	12
t	-0.05%	1.74%	19	0.74%	5.10%	38
t+1	-0.11%	1.25%	8	-0.36%	5.70%	15
t+2	-0.95%	4.19%	44	-0.46%	1.60%	8
t+3	-0.91%	2.65%	9	-0.43%	1.24%	6
t+4	0.82%	1.97%	20	-0.06%	2.49%	45
t+14	-0.65%	1.54%	12	-0.16%	1.35%	8
t+19	0.44%	1.67%	13	-0.15%	2.29%	27

Table 14: 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%	9	-0.15%	2.12%	8	-0.32%	1.28%	6
t-3	-0.25%	1.88%	15	0.24%	1.57%	13	0.50%	1.54%	19
t-2	-0.10%	1.49%	5	-0.11%	1.53%	8	-0.18%	1.66%	21
t-1	-0.05%	1.09%	3	0.53%	1.45%	9	-0.12%	1.13%	8
t	1.02%	2.04%	34	-0.04%	2.05%	14	-0.15%	1.10%	5
t+1	-0.15%	2.12%	8	-0.12%	1.63%	10	0.21%	1.40%	10
t+2	0.23%	1.57%	13	0.04%	1.60%	14	0.44%	2.29%	31
t+3	-0.12%	1.54%	8	-0.17%	1.61%	7	0.19%	2.53%	7
t+4	0.51%	1.45%	9	0.53%	1.46%	7	-0.06%	1.93%	9
t+14	0.07%	1.04%	1	-0.01%	1.05%	4	-0.15%	1.24%	8
t+19	-0.01%	1.05%	4	0.20%	1.33%	9	-0.23%	7.80%	19

estimates and R-squareds are noticeably smaller, suggesting that our GVC variables have little to say about the gap between actual and expected returns in these subsequent events. This gives further support to our assertion that investors adjusted 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 share variables are generally positive (if only occasionally significant), market capitalization is often significantly negative, and the number of affiliates is generally positive with some significance. These are the opposite from what is found in the 24 June results which, since these two events might have led investors to hope that Brexit would not occur, is in line with our overall expectations.

Table 15: 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	-0.00116	-0.00194	-0.0368***	-0.0520***	-0.0389***	-0.0219	0.00100
	(0.00567)	(0.00796)	(0.00921)	(0.0102)	(0.0114)	(0.0196)	(0.0224)
Share of EU Affiliates	0.0172	0.0225*	0.00666	-0.00335	0.00481	0.00610	0.00387
	(0.0107)	(0.0126)	(0.0137)	(0.0157)	(0.0170)	(0.0262)	(0.0340)
Depreciation	-1.119	-0.771	-0.896**	-0.318	-0.0924	0.0450	0.384
	(1.395)	(0.949)	(0.453)	(0.359)	(0.310)	(0.483)	(0.572)
Market Capitalization	-0.00115	-0.00211	-0.000476	0.000928	-0.00318	0.00334	0.00439
	(0.00120)	(0.00161)	(0.00181)	(0.00203)	(0.00215)	(0.00549)	(0.00631)
Number of Affiliates	0.00244***	0.00408***	0.00173	0.00146	0.00150	0.000652	0.00407
	(0.000929)	(0.00154)	(0.00275)	(0.00219)	(0.00230)	(0.00553)	(0.00571)
Constant	-0.00907	-0.00603	0.0166	0.00124	0.0269	-0.0681	-0.113**
	(0.0121)	(0.0155)	(0.0204)	(0.0202)	(0.0224)	(0.0503)	(0.0568)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	339	339	339	339	339	339	339
Adjusted R-squared	0.044	0.046	0.101	0.255	0.134	0.031	0.015

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

Table 16: 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	0.0165	0.0203	0.0110	0.00255	-0.0171	0.0208	0.0700
	(0.0101)	(0.0182)	(0.0116)	(0.0113)	(0.0125)	(0.0258)	(0.0454)
Share of EU Affiliates	0.0128	0.0263	0.0173	0.00655	-0.0198	0.0864**	0.101**
	(0.0171)	(0.0182)	(0.0178)	(0.0180)	(0.0207)	(0.0405)	(0.0489)
Depreciation	0.428	0.699	0.615**	0.557**	0.835**	1.309***	0.0892
	(0.491)	(1.257)	(0.262)	(0.251)	(0.399)	(0.448)	(0.871)
Market Capitalization	-0.00517***	-0.00723***	-0.00761***	-0.00494**	-0.00639**	-0.0186***	-0.0167**
	(0.00176)	(0.00260)	(0.00225)	(0.00228)	(0.00267)	(0.00550)	(0.00736)
Number of Affiliates	0.00239	0.00904*	0.00835*	0.00769*	0.00891*	0.0230***	0.0211**
	(0.00170)	(0.00480)	(0.00451)	(0.00450)	(0.00468)	(0.00665)	(0.00875)
Constant	0.0373**	0.0215	0.0234	0.00529	0.0421*	0.0789*	0.00211
	(0.0155)	(0.0323)	(0.0187)	(0.0186)	(0.0223)	(0.0463)	(0.0746)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	339	339	339	339	339	339	339
Adjusted R-squared	0.009	0.014	0.002	-0.005	0.004	0.045	-0.001

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

Table 17: 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	0.0109**	0.0105	0.0144	0.0156	0.0221*	0.0285*	0.0186
	(0.00503)	(0.00892)	(0.00962)	(0.0113)	(0.0126)	(0.0153)	(0.0186)
Share of EU Affiliates	0.0127*	0.0145	0.0154	0.0215	0.0258*	0.0323	0.0372
	(0.00666)	(0.0110)	(0.0108)	(0.0134)	(0.0151)	(0.0232)	(0.0313)
Depreciation	0.595**	0.293	0.179	0.181	0.221	0.482	0.864
	(0.295)	(0.347)	(0.409)	(0.562)	(0.401)	(0.670)	(0.581)
Market Capitalization	-0.00141	-0.00138	-0.00236*	-0.00360**	-0.00494**	-0.00806**	-0.0110**
	(0.00110)	(0.00112)	(0.00135)	(0.00169)	(0.00205)	(0.00358)	(0.00443)
Number of Affiliates	0.00193	-0.000744	-0.000460	0.000775	0.00154	0.00115	0.00358
	(0.00134)	(0.00106)	(0.00140)	(0.00190)	(0.00211)	(0.00279)	(0.00357)
Constant	0.0102	0.0200**	0.0250**	0.0289*	0.0408**	0.0771**	0.108***
	(0.00912)	(0.00914)	(0.0120)	(0.0154)	(0.0180)	(0.0305)	(0.0369)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	339	339	339	339	339	339	339
Adjusted R-squared	0.100	0.023	0.031	0.015	0.038	0.032	0.027

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

Table 18: January 24 (High 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	0.00344	0.00134	-0.000799	0.00678	0.0171**	0.0190	0.0216
	(0.00510)	(0.00654)	(0.00739)	(0.00746)	(0.00777)	(0.0141)	(0.0219)
Share of EU Affiliates	0.000856	0.0155	0.0149	0.0109	0.0190	0.0243	0.00969
	(0.00947)	(0.0106)	(0.0136)	(0.0128)	(0.0149)	(0.0361)	(0.0391)
Depreciation	0.715	1.522**	1.034	0.937	1.126	1.359	0.285
	(1.345)	(0.771)	(0.747)	(1.159)	(1.172)	(1.290)	(1.620)
Market Capitalization	-0.00387**	-0.00358*	-0.00434*	-0.00161	-0.00199	-0.00758*	-0.00308
	(0.00182)	(0.00201)	(0.00225)	(0.00234)	(0.00231)	(0.00390)	(0.00428)
Number of Affiliates	0.00112	0.00381***	0.00389***	0.00288**	0.00149	0.00118	-0.00170
	(0.000830)	(0.00141)	(0.00144)	(0.00139)	(0.00144)	(0.00252)	(0.00312)
Constant	0.0333**	0.0248	0.0262	0.00149	0.00622	0.0639**	0.0421
	(0.0158)	(0.0175)	(0.0188)	(0.0197)	(0.0195)	(0.0298)	(0.0367)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	339	339	339	339	339	339	339
Adjusted R-squared	0.055	0.026	0.016	-0.010	-0.001	0.007	0.006

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

Table 19: 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	-0.0128**	-0.0126**	-0.00117	-0.00265	-0.00546	0.0153	0.00712
	(0.00563)	(0.00601)	(0.00663)	(0.00870)	(0.00987)	(0.0308)	(0.0375)
Share of EU Affiliates	-0.0128	-0.00438	-0.00766	-0.00923	-0.00636	0.0184	0.0295
	(0.00893)	(0.0122)	(0.0147)	(0.0161)	(0.0177)	(0.0204)	(0.0285)
Depreciation	-0.689	0.435	0.452	0.529	0.448	0.656	0.387
	(0.570)	(0.583)	(0.657)	(0.568)	(0.708)	(0.865)	(1.009)
Market Capitalization	-0.00103	-0.00252**	-0.00223	-0.00272	-0.00300	-0.00570	-0.00542
	(0.000796)	(0.00103)	(0.00150)	(0.00179)	(0.00185)	(0.00370)	(0.00447)
Number of Affiliates	0.00109*	0.000974	0.00121	7.89e-05	-0.000746	0.000194	0.00745
	(0.000595)	(0.000759)	(0.00142)	(0.00198)	(0.00161)	(0.00295)	(0.00599)
Constant	0.0133	0.0251**	0.0175	0.0311**	0.0373**	0.0722	0.0332
	(0.00890)	(0.00977)	(0.0118)	(0.0148)	(0.0162)	(0.0490)	(0.0616)
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	338	338	338	338	338	338	338
Adjusted R-squared	0.063	0.143	0.019	0.004	0.025	0.043	0.030
Sector FE	YES	YES	YES	YES	YES	YES	YES
Observations	339	339	339	339	339	339	339
Adjusted R-squared	0.055	0.026	0.016	-0.010	-0.001	0.007	0.006

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 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 expectations, we instead analyze the expectations embodied in stock market price movements. Using data from the FTSE 350, we show two key things.

First, 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, we find that the firm does better relative to the market the more the Sterling depreciated relative to its other key currencies. This, however, is counteracted by the rising cost of imports, with firms in industries especially dependent on intermediate input imports relatively injured by the depreciation. 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.

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 success. 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 and 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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