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The Global Impact of Brexit Uncertainty*

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ABSTRACT

Using tools from computational linguistics, we construct new measures of the impact of Brexit on listed firms in the United States and around the world: the share of discussions in quarterly earnings conference calls on costs, benefits, and risks associated with the UK's intention to leave the EU. Using this approach, we identify which firms expect to gain or lose from Brexit and

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which are most affected by Brexit uncertainty. We then estimate the effects of these different kinds of Brexit exposure on firm-level outcomes. We find that concerns about Brexit-related uncertainty extend far beyond British or even European firms. US and international firms most exposed to Brexit uncertainty have lost a substantial fraction of their market value and have reduced hiring and investment. In addition to Brexit uncertainty (the second moment), we find that international firms overwhelmingly expect negative direct effects of Brexit (the first moment), should it come to pass. Most prominently, firms expect difficulties resulting from regulatory divergence, reduced labor mobility, trade access, and the costs of adjusting their operations post-Brexit. Consistent with the predictions of canonical theory, this negative sentiment is recognized and priced in stock markets but has not yet had significant effects on firm actions.

JEL Codes: D8, E22, E24, E32, E6, F0, G18, G32, G38, H32

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Three years after the British vote for Brexit, ample uncertainty remains on whether, when, and on what terms the UK will leave the EU—and how the future economic relation between the EU and its estranged member country will evolve. While this persistent uncertainty clearly weighs on the minds of British voters (witness Boris Johnson's pledge to "get Brexit done"), many commentators, business leaders, and politicians have also pointed to its high economic costs. Some British and European leaders have even gone so far as to suggest that it might be preferable for the UK to leave the EU even without an orderly negotiated deal than to endure additional years of uncertainty.[1]

Indeed, corporate executives and stock-market participants (investors, financial analysts) around the world have had to divine how a bewildering sequence of hard and soft Brexit proposals by a succession of British prime ministers might affect firm business. How is the prospect of Brexit, and the related uncertainty, affecting firms' actions?

While economists have made some progress in estimating the direct and indirect effects of Brexit on UK-based firms, attempts to quantify their effect on firms outside the UK and document their response, has proven more difficult. Indeed, the exposure of firms around the world to Brexit is hard to measure for at least three reasons. First, Brexit exposure can derive from many, potentially interdependent, sources, including barriers to product market access; obstacles to managing relationships with customers, suppliers, and subsidiaries; and difficulties in engaging in investments and takeover activities. Attempts to quantify international firms' Brexit exposure thus risk overlooking some economically meaningful but potentially indirect determinants of exposure. Second, exposure to Brexit is not a time invariant trait of firms. Indeed, the prolonged political process for deciding on a response to the outcome of the 2016 referendum has yielded a sequence of potential negotiation outcomes, each of which come with different implications for a given firm. A firm might be a Brexit "winner" one day, only to face being in a disadvantaged position the next. Thus, with shocks such as Brexit, which vary substantially over time in both scope

[1]Most notably, French President Emmanuel Macron has publicly taken this position (Waterfield et al. (2019) in *The Times*).

and potential outcome, a measure of exposure to the shock needs to be able to "track" its longitudinal impact, while also accounting for cross-sectional variation. Third, exposure to Brexit derives not only from its impact on uncertainty (second moment), but also from how Brexit affects expectations about the mean (first moment). Indeed, before Brexit "gets done" one might expect that most of the impact occurs through uncertainty, with mean effects perhaps being limited to firms' spending on preparing for the implementation and taking precautionary measures to reduce the impact. Ultimately, however, quantifying such first and second moment effects of Brexit must be achieved empirically.

Our study addresses each of these three challenges. We propose a general text-classification method for isolating first and second moment shocks relating to specific events (Gentzkow et al., 2019; Hassan et al., 2019). Our approach identifies the exposure of firms to a given event (in our case "Brexit") simply by counting the number of times the event is mentioned in a given firm's (quarterly) earnings conference call with financial analysts. These conference calls usually happen in conjunction with an earnings release and are used by management to present their take on the current affairs of the company. Importantly, after the management's presentation of financial results, a Q&A session ensues during which analysts probe management on what they believe are challenges the firm is facing. In this "market place" for information, our intuition is that managers and analysts devote more time to events with greater importance to the firm, making the time spent discussing a particular event a powerful measure of firm's exposure to said event. As call participants are arguably among the foremost experts on the firm's business, any potential impact of Brexit—be it through financial, product, or labor markets or otherwise—will likely come up in conversation. Concerns about missing out on some (for researchers) difficult to observe ways in which Brexit might influence a firm in a faraway country are therefore plausibly mitigated. Using these calls to measure Brexit exposure thus allows us to identify its market-assessed, over-time variation, from the moment talks of a Brexit referendum began (i.e., before 2016), until the present period. Indeed, our method allows us to track changes in firm-level Brexit exposure

(due to, for example, developments in the EU-UK negotiations) over time, and without the need to conduct surveys of executives in multiple countries. Last, we adapt the Hassan et al. (2019) (HHLT) method of measuring firm-level political risk and sentiment, to bifurcate our overall measure of Brexit exposure into first moment (*BrexitSentiment*) and second moment (*BrexitRisk*) scores. Intuitively, we determine whether call participants use "risk" or "uncertainty" synonym words in the neighborhood of the term "Brexit" to measure *BrexitRisk* and positive and negative tone words in the vicinity to "Brexit" to capture *BrexitSentiment*.

Using these newly constructed measures, we are able to document a set of novel empirical findings on the impact of Brexit on firms in 71 countries around the world. While we present these findings as part of our effort to validate our Brexit exposure measures, they are significant in their own right. For example, we show that not only does the concern among UK firms explode in the most recent quarters of our sample period (which extends to the second quarter of 2019, and thus a period where a "no deal" Brexit became a real possibility), but worries about Brexit-related risks among *global* firms is widespread. Indeed, Irish firms, for example, discuss Brexit on average significantly more than UK firms in their earnings calls. Remarkably, perhaps, Brexit exposure is felt as far afield as the United States, South Africa, and Singapore.

Noteworthy is also that UK and non-UK firms alike overwhelmingly expect *negative* consequences from Brexit. When we aggregate the sentiment associated with Brexit to the country level, we find not a single country for which the average is significantly positive. Possible exceptions are firms operating in extraterritorial tax havens, such as the UK Channel Islands and the British Virigin Islands (where the average Brexit Sentiment of local firms is positive, though not statistically distinguishable from zero). We probe this finding further by conducting a human audit of the text snippets in those conference calls that mention Brexit to determine the content of the associated discussions. We find firms mostly expecting headwinds due to regulatory divergence, reduced labor mobility, reduced trade access, and heightened uncertainty.

At the firm level, we do find some instances of positive outlooks—the most optimistic text snippets mention managers expecting little exposure to Brexit or having windfalls due to the Brexit-induced depreciation of the British Pound. Notably, we find litte or no discussion of the major economic benefits touted by the Leave campaign, such as looser regulation or better trade deals, even among UK-based firms.[2]

We then turn to the question of how US and international firms respond to their Brexit exposure. Exploiting our time-varying firm-level measure, we show that Brexit exposure mostly affects firm-level actions due to risk rather than sentiment. Indeed, we show large, negative effects of *BrexitRisk* on investment and employment decisions, productivity, and contemporaneous stock returns. For example, we estimate that, due to Brexit risk, the average Irish firm decreased its investment rate by 4.2% and reduced its employment growth rate by 15% relative to the mean in every year since the Brexit referendum. For US-based firms (which on average are less exposed to Brexit than Irish firms) corresponding reductions in investment and employment growth rates are 0.5% and 1.7%.

We supplement these analyses with two further key pieces of evidence. First, we investigate how stock markets react to information about the (surprising) outcome of the 2016 referendum to leave the EU. Pricing effects of the Brexit vote can be due to this shock affecting the expected discount rate or because the vote changes the market's expectation of future cash flows (Gorbatikov et al., 2019). We disentangle these two sources of asset pricing implications and show that the mean of firm level exposure to Brexit (i.e., *BrexitSentiment*) is positively associated with stock returns in a narrow event window around the date of the referendum, whereas the variance of firm-level exposure (i.e., *BrexitRisk*) is significantly negatively associated with the same. In other words, both first- and second-moment exposure to Brexit is quickly incorporated into stock prices once the referendum result is announced.

Second, we examine whether the average Brexit exposure of firms located in a given

[2]The Leave campaign focused on deregulation (from EU laws), creating new jobs, reducing the UK contributions to the EU, and increasing trade/exports by allowing new trade agreements to be made on sovereign terms. See: http://www.voteleavetakecontrol.org/our_case.html

county in the UK is associated with the share of the electorate that votes to leave the EU in the 2016 referendum. Our findings show that constituents living closer to the most negatively affected firms tended to vote "remain." For example, a one-standard-deviation increase in the county-level Brexit risk is associated with a 1.4 percentage-point decrease in the proportion of votes in favor of leaving the EU.

Taking this new evidence together, we conclude that the Brexit vote, to date, has been mostly an uncertainty shock. Whereas stock markets have recognized and priced both the expected effects on future cash flows and discount rates, the first moment effects of Brexit have not been realized yet. Indeed, firms have so far responded in their real decisions to the increased uncertainty, but not to changes in the mean of the firm's exposure to Brexit (i.e., whether the shock is good or bad news for the firm). In this sense, our analysis shows that much of the Brexit effect has yet to materialize.

Related literature. Our paper builds on several strands of literature. In particular, we rely on ideas espoused in the literature on investment under uncertainty, which avers that any increase in risk should decrease the firm's investment and employment growth (e.g., Pindyck (1988); Bernanke (1983); Dixit and Pindyck (1994); Bloom et al. (2007)).[3] A small set of studies attempts to quantify specifically the impact of Brexit uncertainty. For example, Bloom et al. (2019) use a survey of decision makers in UK firms to measure Brexit-related uncertainty and its associated (negative) effects on investment and productivity. One suggestive result in their paper is that more productive, internationally exposed firms have been more negatively impacted than less productive domestic firms.[4] While we likewise show economically meaningful negative consequences on UK firms, we complement these studies

[3]In macroeconomic models, increases in aggregate risk may increase or decrease aggregate investment, because of general equilibrium effects on the interest rate (see, e.g., Fernández-Villaverde et al. (2015); Hassan and Mertens (2017)). However, this ambiguity usually does not exist at the firm level (i.e., conditional on a time fixed effect). In models with adjustment costs, a firm that faces relative increases in firm-level risk should always decrease its investment relative to other firms.

[4]Other papers documenting a negative impact of Brexit on UK investments, employment wages, trade, lending, and competition include Born et al. (2019); Berg et al. (2019); Van Reenen (2016); Sampson (2017); Breinlich et al. (2018); Davies and Studnicka (2018); Dhingra et al. (2017); Graziano et al. (2018); Garetto et al. (2019); Costa et al. (2019); McGrattan and Waddle (2017); Steinberg (2019).

by highlighting the economic consequences of Brexit for non-UK firms, documenting the perhaps surprisingly far-reaching global effects associated with this shock.[5] Our method not only allows us to explore the impact of *exposure* to Brexit across our sample firms, but also to disentangle the effect of Brexit on the variance (second moment) from the effect on the mean. In this way, we are able to provide a deeper understanding of how cross-sectional variation in Brexit risk goes together with receiving (bad or good) news about the mean of the political shock, i.e., Brexit's expected effect on future cash flows. While the ability to quantify firm-level Brexit exposure and trace its development over time is valuable in its own right, our method provides additional color to the analysis as we can use the source text of the conference calls to better describe the specific concerns firms have about Brexit at any given moment.

We also add to an important literature on the microeconomic effects of uncertainty (Bloom et al., 2018). While studies have shown uncertainty to have far-reaching consequences on firm policies of first order importance, such as investments and hiring, this work is hampered by the lack of "sound, flexible measures of uncertainty" (Altig et al., 2019). We highlight the versatility of text-based measurement to obtain such measures adding to recent work which has pioneered these approaches in the context of political uncertainty (Baker et al., 2016; Hassan et al., 2019) and applied them to such themes as trade policy (Handley and Li, 2018; Caldara et al., 2019; Kost, 2019).

Finally, our results also speak to a large literature in international macroeconomics on spill-overs of shocks across borders and "contagion." A long-standing idea in this literature is that an uncertainty shock originating in one part of the world can affect valuations and investment in faraway places (Forbes and Warnock, 2012; Rey, 2015). In this sense, our work shows a concrete and well-identified example of such a spill-over, where a shock originating in the UK affects valuations, investment, and other precautionary behavior in the United States and other countries.

[5] Campello et al. (2018) document investment and hiring effects of Brexit on a sample of US firms exposed to the UK economy.

1. Data

Our primary source of data is transcripts of quarterly earnings conference calls by publicly listed firms. From Refinitiv EIKON, we collect the complete set of 145,902 transcripts of English-language earnings conference calls, held from 2011 to 2019, of 7,733 firms headquartered in 71 countries. Firms host these calls in conjunction with their earnings announcements, allowing financial analysts and other market participants to ask questions about the firm's financial performance in the past quarter as well as more broadly discuss current affairs with senior management (Hollander et al., 2010).[6] Our data coverage, as shown in Table 1, panel A, consists of 7,733 unique firms, of which 1,367 are headquartered in EU countries (including 396 firms in the UK), 3,791 in the United States, and 2,575 in the rest of the world. Panel B shows in more detail the extensive coverage of listed firms across the globe in our sample. This coverage is important as Brexit exposure is likely not simply limited to firms with headquarters in the UK or in adjacent countries: firms may have subsidiaries, suppliers, customers, competitors, or shareholders in the UK; or they may use UK facilities as a hub for hiring or otherwise communicate through the UK. To illustrate, of the roughly 3,800 US-based firms, 1,633 disclose to have establishments located in the UK.

Financial statement data, including information on employment, investments, revenues, and earnings, are taken from the Standard and Poor's Compustat North America (US) and Compustat Global (non-US) files. Stock information is from the Center for Research in Security Prices. UK county voting results on the Brexit referendum as well as basic demographic data on these counties are from the Office for National Statistics.

[6] Alternatively, we could have used a given firm's annual report (10-K filing) as a text source (see, Campello et al. (2018)). We decided against this approach in view of HHLT, who document better measurement properties of firm-level risk measures based on conference call transcripts rather than on financial statements. Anecdotally, the SEC Chairman, Mr. Jay Clayton, lamented, according to a Wall Street Journal report, that firms do not sufficiently disclose the potential risk posed by Brexit (Shumsky, 2018). If so, then relying on 10-Ks would plausibly underestimate the firm's exposure to the shock.

2. Measuring Firm-Level Brexit Risk and Brexit Sentiment

To create a time-varying measure of a given firm's Brexit *exposure*, we simply parse the earnings call transcripts and count the number of times the word "Brexit" is used and divide by the total number of words in the transcript (to account for differences in transcript length)[7]

$$BrexitExposure_{it} = \frac{1}{B_{it}} \sum_{b=1}^{B_{it}} 1[b = Brexit],$$

where $b = 0, 1, ...B_{it}$ are the words contained in call of firm i in quarter t.[8]

To construct a measure of Brexit *risk*, we augment this procedure by conditioning on the proximity to a synonym for risk or uncertainty:

$$BrexitRisk_{it} = \frac{1}{B_{it}} \sum_{b=1}^{B_{it}} \{1[b = Brexit] \times 1[|b - r| < 10]\},$$

where r is the position of the nearest synonym of risk or uncertainty. We condition on a neighborhood of 10 words before and after the mentioning of Brexit, following the example of HHLT. As in this study, we obtain a list of synonyms for "risk" and "uncertainty" from the Oxford English Dictionary. To aid interpretation throughout this study, we standardize $BrexitRisk$ by the average $BrexitRisk$ for UK headquartered firms measured in the period after the Brexit referendum (i.e., after the second quarter of 2016).

A major challenge in the measurement of risk is that innovations to the variance of shocks are likely correlated with innovations to the conditional mean. For example, a French exporter who learns that there may be future tariffs on her exports to the UK may conclude that she faces lower expected profits (a lower conditional mean) as well as higher variance

[7] Google Trends shows the first usage of the term "Brexit" in October 2012. Usage of the word increased in January 2016 and peaked in June 2016. "Br*i*xit" was proposed as an alternative term for Britain exiting the EU, but never records a meaningful volume on Google Trends in the sample period.

[8] Note that this simple procedure can easily be modified to obtain counts of variations on Brexit, e.g., "hard" or "soft" Brexit, as well as other phrases that have become meaningful in the aftermath of the Brexit referendum, such as "no deal", "WTO terms", and so on.

(the tariffs may or may not materialize). Thus, teasing out the effects of Brexit-related uncertainty on a firm's actions also requires controlling for Brexit's effect on the conditional mean of the firm's future earnings. To this end, the construction of Brexit *sentiment* closely follows the procedure for *BrexitRisk* by counting the use of the word Brexit, but instead of conditioning on the proximity to words associated with risk, we condition on words representing positive or negative tone words to capture the first moment. These positive and negative words are identified using the Loughran and McDonald (2011) sentiment dictionary.

$$BrexitSentiment_{it} = \frac{1}{B_{it}} \sum_{b=1}^{B_{it}} \left\{ \{1[b = Brexit] \times \left(\sum_{c=b-10}^{b+10} S(c) \right) \right\},$$

where S assigns sentiment to each c:

$$S(c) = \begin{cases} +1 \text{ if } c \in \mathbb{S}^{+} \\ -1 \text{ if } c \in \mathbb{S}^{-} \\ 0 \text{ otherwise.} \end{cases}$$

As was the case for *BrexitRisk*, we also standardize *BrexitSentiment* by the average *BrexitSentiment* for UK headquartered firms post 2016 Q2. Here a value of -1 denotes the average net sentiment of UK firms after 2016.

For use in robustness checks and as control variables we also measure each firm's non-Brexit-related risk and sentiment using the same the firm's non-Brexit-related risk following the same approach as above:

$$NonBrexitRisk_{it} = \frac{1}{B_{it}} \sum_{b}^{B_{it}} \{1[b \in \mathbb{R}]\} - BrexitRisk_{it},$$

and

$$NonBrexitSentiment_{it} = \frac{1}{B_{it}} \sum_{b}^{B_{it}} S(b) - BrexitSentiment_{it}.$$

3. Validation

3.1. Global Exposure to Brexit

In this section, we explore the properties of our three measures, *BrexitExposure*, *BrexitRisk*, and *BrexitSentiment*, to corroborate their capturing firm-level variation in the global corporate response to Brexit. We first show that *BrexitExposure* correlates significantly with the location of the firm's operational headquarters (in the UK or elsewhere), the firm reporting to have UK subsidiaries, and the firm's proportion of revenues earned in the UK. We then consider the constituent parts of *BrexitExposure* separately and describe in detail the patterns of both *BrexitRisk* and *BrexitSentiment* over time and across countries. To further validate our method, we present the results of a human audit of the text fragments ("snippets") in which Brexit is mentioned.

Exposure. Table 2 presents cross-sectional regressions of the mean *BrexitExposure* for each firm across time onto firm specific characteristics that are *ex ante* likely to affect the exposure of a given firm to Brexit. In particular, we consider the geographical location of the firm's operational headquarters and its establishments as well as its proportion of total (worldwide) sales earned in the UK. In view of the stickiness of firm location choices, we average the Brexit exposure of each firm across the sample period spanning from 2016 until the first quarter of 2019 and report robust standard errors. Columns 1 and 2 in Table 2 only consider geographical location (and have a larger number of observations), while columns 3-4 also include the proportion of UK sales. Across specifications, we find a positive association between mean *BrexitExposure* and the firm having a UK subsidiary. The estimated coefficient is about 0.2 implying that foreign firms with UK subsidiaries on average mention Brexit one fifth as often as firms that are headquartered in the UK. (Recall that our measure of Brexit exposure is normalized so that the average exposure of a UK firm during the 2016-19 period is one.) We find a similar positive association between a firm having UK headquarters and mean *BrexitExposure*, but the estimated coefficient is

sensitive to including the proportion of UK sales revenues in the regression. We include two different proxies for UK revenues, the first based on the UK sales reported *before* the Brexit vote and the second based on the period *after* the vote. We also find that firms with headquarters in the EU, but outside the UK, are more exposed to Brexit than firms with headquarters elsewhere in the world. Once more, this effect appears to be subsumed by post-referendum UK sales. Taken together, these findings are consistent with the notion that $BrexitExposure$ varies meaningfully with those firm characteristics that increase the probability of a firm being commercially connected to the UK.

Risk and Sentiment. Having offered evidence in support of the validity of $BrexitExposure$, we explore the properties of $BrexitRisk$ and $BrexitSentiment$ next. Figure 1, panel A plots the average across firms of $BrexitRisk$ at each point in time for firms grouped by headquarter location in either the UK or the rest of the world. Consistent with the outcome of the Brexit vote in 2016 being a surprise to most parties, we find very low levels of $BrexitRisk$ before 2016, both in the UK (right) and in the rest of the world (left). $BrexitRisk$ ticks up somewhat in the first half of 2016, in the run up to the referendum. Non-UK firms have a peak in $BrexitRisk$ in the immediate aftermath of the referendum, in which the average $BrexitRisk$ is about 0.8; in other words, Brexit risk for firms outside the UK reaches almost the height of the average Brexit risk experienced by UK firms after 2016. We find a similar peak for UK firms, with average $BrexitRisk$ reaching over 1,5 immediately following the referendum.[9] While $BrexitRisk$ subsides in 2017, it rises sharply again in the second half of 2018, reaching close to 3 for UK firms (and about 0.5 for non-UK firms). This time-series pattern closely mimics the tribulations of the negotiation process between the EU and the UK, in which, in particular at the end of 2018, the specifics of the deal reached between Theresa May's government and the EU became increasingly clear, as well as the difficulties facing the UK government to obtain parliamentary approval for the outcome. In 2019, when our sample ends, the prospect of the UK leaving the EU without a deal, resorting back to

[9] Fisman and Zitzewitz (2019) show a similar (aggregate) pattern for the July-December 2016 period using their Brexit Long-Short Index, based on stock returns of equities.

WTO trade terms, gained credence, consistent with the uncertainty about Brexit reaching unprecedented levels in the UK at that time.

Figure 2 shows the average *BrexitRisk* by country of the firm's headquarters, for all countries that have non-zero Brexit risk and a minimum of five firms with headquarters located in the country. Country level values are calculated by taking the mean *BrexitRisk* over all firms headquartered in a given country and computing each firm's average *BrexitRisk* using all available observations after 2016. Countries with zero country-level *BrexitRisk* include those at some distance from the UK, such as, Thailand, Nigeria, and Argentina; we also do not register any Brexit risk in some nearby countries including Portugal and the Czech Republic. By construction, the UK country-level *BrexitRisk* in this period equals unity. Perhaps the most eye-catching takeaway from the figure is the position of Ireland recording a country-level Brexit risk of 1.68, far greater than the Brexit risk of the average UK firm.[10] Distance to the UK matters as other countries with high scores include nearby France, the Netherlands, Belgium and Denmark, all of which are EU member states. Among the non-EU countries most affected by Brexit risk are South Africa, Switzerland, Singapore, and Australia. Longstanding Commonwealth ties connect many of the non-EU countries with relatively high Brexit risk scores. The Channel Islands, on the other hand, being part neither of the Commmonwealth nor of the EU, are major offshore financial centers and tax havens. Their *BrexitRisk* falls between the UK's (of which it is also not a part) and Ireland's. In all, EU-member states appear to have higher country-level Brexit risk than those affected countries in other parts of the world. The *BrexitRisk* of the average US firm is 0.11, that is, around 10% of that of the average UK firm and similar to the average *BrexitRisk* of Italian firms.

In Figure 3, we plot the mean *BrexitRisk* by industry for both UK and non-UK head-

[10]This difference is statistically significant, though we do not show confidence intervals to save space. Interestingly, this finding mirrors the result in Garetto et al. (2019), who quantify in a model the total welfare effect of Brexit on EU economies. They find the Brexit shock to reduce purchasing power (i.e., real income) the most in Ireland. More generally, the literature on geography and trade has argued that market and supplier access to neighboring countries are most important for small economies (Redding and Venables, 2004).

quartered firms. The mean industry *BrexitRisk* is computed by averaging across all firms in a particular industry. We observe that in almost all industries (the exception is Health Services), the mean *BrexitRisk* in the UK is significantly larger than in the non-UK. The difference between the UK and the rest-of-the-world is particularly prominent in the Services and Finance, Insurance, and Real Estate industries.

In a final step, we tabulate and review text fragments that center around the moment in the earnings call when the conversation turns to Brexit and its associated risks. Table 3 reports excerpts of the transcripts with the highest *BrexitRisk* among the subset of firms with the highest firm-level *BrexitRisk*. In panel A, these exerpts are taken from UK companies such as Bellway, Millennium and Copthorne Hotels, and Endava and date from 2016 to 2019. In all of these cases, a reading of the snippets confirms that call participants are discussing risks associated with Brexit. For example, the July-2017 transcript of Berendsen Ltd. says "however Brexit raises any number of uncertainties for every single business ...". Or, in case of SThree Plc in January 2019: "...theres also a lot of uncertainty around the UK and Brexit and that will affect most markets ...". In panel B, we show snippets from companies headquartered outside of the UK, discussing Brexit in their earnings calls. The examples of top scoring transcripts are from a range of countries and across the post-Brexit referendum sample period. In all cases, reading the text confirms that the discussion centers on Brexit related uncertainty facing the firm. The Swedish firm Sweco, for example, in October 2018 mentions "there is still an uncertainty when it comes to Brexit and some weakness in the real estate market ...". Likewise, FBD Holdings from Ireland records "our agri and agribusiness customers are very exposed to a hard Brexit ..." during their January 2019 call.

We then repeat these same steps for *BrexitSentiment*, starting with a plot of the respective time series for UK and non-UK firms, in Figure 1, panel B.[11] Overall, for both the UK and non-UK firms, *BrexitSentiment* is negative. We observe a sharp fall in sentiment in

[11] The correlation between *BrexitRisk* and *BrexitSentiment* in the firm-year panel beginning in 2016 is 0.16.

the immediate aftermath of the Brexit referendum, more pronounced in the UK than in the non-UK, with sentiment scores reverting back to slightly below zero in most of 2017. Starting from 2018, both inside the UK and in the rest of the world, average *BrexitSentiment* drops sharply, especially in the UK, with the drop continuing well into 2019.

Figure 4 plots mean *BrexitSentiment* by country. Again, overwhelmingly, the sentiment in the UK and elsewhere is negative. Once more, Ireland has the strongest negative sentiment scores, even larger than those of the UK. However, firms in Germany and Austria, together with firms in other EU member states such as Italy, Denmark, Sweden and France share strongly negative views on the impact of Brexit. The one "anomalous" finding is for the UK Channel Islands, where *BrexitSentiment* is hugely positive (with a value of +2, truncated in the figure to save space). Due to the limited number of firms based in the Channel Island (8), however, we lack the statistical power to distinguish even their *BrexitSentiment* from zero.

These findings raise the question what specific concerns underlie this documented aggregate negative sentiment in most countries. What's more, for those firms that expect to benefit from Brexit, what advantages do they perceive? We answer these questions by reading a total of 349 positive sentiment text excerpts (of which 128 convey a specific enough meaning to be classified) and 549 negative sentiment text fragments (of which 162 mention specific reasoning). We classify the perceived benefits and concerns into six categories each. These categories are chosen based on an initial reading of the text excerpts, and with an eye to the concerns and benefits raised by politicians and other pundits active in the public debate about Brexit. Turning our attention to the excerpts that express a positive sentiment about Brexit in Table 4 first, we find that over 80 percent of positive snippets both in the UK and elsewhere in the world mention that the firm is *not* exposed to Brexit and therefore does not expect to be much affected. The second most important reason for an excerpt to be recorded as expressing positive sentiment corresponds to the benefits of a weak pound. A telling example comes from the transcript of Millennium and Copthorne Hotels, who men-

tion that they "...saw a spike in leisure occupancy after the Brexit referendum in June as tourists took advantage of the cheaper pound ...". About 20 percent of positive snippets from both the UK and non-UK firms can be classified in this category. The only other positive sentiment for UK firms derives from relocation opportunities (4.55 percent). Snippets from non-UK firms additionally highlight positive sentiment due to benefits associated with higher government expenditures or to better trade access. For example, the Frankfurt-based Deutsche Boerse AG considers the scenario in which Brexit negatively affects the attractiveness of London as a place of business and mentions "potential opportunity coming from Brexit and we've seen a number of firms announcing that Frankfurt would ultimately be their European hub." An analyst on the call of the Dutch firm ForFarmers thinks "Brexit could be beneficial for ForFarmers. I understand that it might have a positive impact on your position in the UK".

Importantly, we find not a single excerpt among UK-based firms that refers to any of the three major potential economic upsides of Brexit touted during the Brexit referendum campaign. Not a single UK-based firm expresses positive sentiment about Brexit relating to better trade deals, less regulation, or more flexibility in UK government spending post-Brexit.

As one might expect, some foreseen outcomes of Brexit are considered to be positives for certain firms, but a negative for others. Indeed, as tabulated in Table 4, worsening *trade access* and the *weak pound* are found as clarification for negative Brexit sentiment in 5.88 (26.21) and 47.06 (60.69) percent of the snippets for (non-)UK firms. Fears about worse trade access are particularly prominent for non-UK firms, as illustrated by the snippet from the Irish budget airline Ryan Air Holdings: "if the UK is unable to negotiate access to the single market or open skies it may have implications for our three UK domestic routes ...". UK firms seem more negative than non-UK firms about *adjustment and transition costs*, with about 18 percent of the UK snippets mentioning costs related to Brexit preparations and only 0.69 percent of non-UK firms describing the same. *New and/or multiple regulatory*

regimes and *labor market frictions* appear in equal measure (about 10 percent) of snippets of UK and non-UK firms. For example, the Russian Yunipro expresses the hope that "... for the implementation of the Brexit, reasonable solutions will be found that will preserve to a large extent the rules of the single market for energy". *Falling consumer confidence*, our final category, is mostly associated with snippets from UK firms (5.88 percent compared to 1.38 percent).

Taking these findings together, the following picture emerges. In the UK, Brexit sentiment is negative on average and has precipitously declined since the last quarter of 2018. In that same period, average Brexit risk, which peaked after the 2016 referendum, has steeply increased, surpassing the risk measured immediately after the vote. Overwhelmingly, the negative sentiment at the firm-level in the UK derives from the weak pound, preparation costs for Brexit, and the possibility of facing multiple regulatory regimes post-Brexit. Even those firms who are hopeful about their outlook, in vast majority, base this on either their lack of exposure to Brexit or on the depreciation of the currency. Outside the UK, countries on average mirror the time series pattern in risk and sentiment in the UK, albeit in somewhat more subdued tones. EU member states generally witness higher Brexit risk than countries father afield and, with a small number of exceptions, their sentiment is negative.[12] At the firm-level, negative Brexit sentiment outside the UK relates mostly to the weak pound and concerns about trade access.

3.2. Event Study: The Asset Market Effects of Brexit

We now turn to the asset pricing implications of the referendum vote to leave the EU on June 23, 2016. It is helpful to recall that the outcome of the vote was a complete surprise to most (Fisman and Zitzewitz, 2019). Polling in the preceding months had persistently shown a "Remain" victory (Born et al., 2019). Famously, the British politician Boris Johnson, one

[12]These findings are broadly consistent with Vandenbussche et al. (2019), who find, based on a country-sector analysis substantial losses in value added and employment across the 27 EU member states, but with significant heterogeneity in effect sizes corresponding to a country's position in the global value chain.

of the then leading figures of the Leave campaign, went to bed resigned to the idea that the Remain camp had edged the vote only to wake up in the morning by the sound of booing Remain demonstrators protesting the vote outcome at his private residence.[13] This lack of anticipation of the outcome creates favorable conditions for using an event study to assess the asset pricing effects of Brexit. When investors received the news about the Brexit vote, they formed new expectations about the future of publicly listed firms. Stock price changes capture changes in investors' expectations about the direct and indirect consequences of Brexit on the cash flows of the firm and on its discount rate (Fisman, 2001; Hill et al., 2019; Davies and Studnicka, 2018). For this reason, we investigate how firms' equity prices respond to the Brexit vote, which captures the market's assessment of a given firm's exposure to Brexit. Correlating the market's assessment with our measures of Brexit exposure then also serves to validate our method.

Summary statistics. Table 5 presents the mean, median and standard deviation of the variables used in the event study. We also provide (in columns 4 and 6) the mean and standard deviation of each variable for the sub samples of the UK and the rest-of-the-world. Our key variables of interest are, as before, Brexit exposure, risk, and sentiment. For the purpose of this analysis, we consider both the "average Brexit" and "pre-Brexit" *Exposure*, *Risk*, and *Sentiment*. Average Brexit variables are computed by averaging all available Brexit scores for the years 2016-19, whereas pre-Brexit variables are based on the sample of earnings conference calls ending before June 23, 2016. Brexit exposure, risk and sentiment are larger (in absolute value) in the UK than in the rest-of-the-world, no matter whether calculated over the firm's life time (in the panel) or before the Brexit vote. For example, the mean $\overline{BrexitRisk}$ in the full sample is 0.195, but for the UK sample, the corresponding value equals 1 (by construction). Sentiment is on average negative, reflecting that sentiment across our sample is negative rather than positive. Median values of Brexit-related variables are zero, consistent with Brexit being discussed in the transcripts of a selected group of firms.[14]

[13] According to an ITV report of 24 June 2016.

[14] We construe this finding as consistent with analysts and senior management only discussing Brexit when

Stock returns are calculated using a narrow window starting on June 24 and ending on June 28, 2016, thus containing four trading days (as the referendum took place on a Thursday).[15]

Regression results. In Table 6, we present estimates of Ordinary Least Squares regressions of the following form:

$$r_i = \alpha_0 + \delta_j + \delta_c + \beta Brexit_i + X_i^{'}\nu + \epsilon_i \tag{1}$$

where $r_{i,t}$ is the four-trading day return following the Brexit vote; δ_j and δ_c are industry and headquarter country fixed effects, respectively, $Brexit_i$ represents either $\overline{BrexitExposure}$, $\overline{BrexitRisk}$, $\overline{BrexitSentiment}$, $Pre-BrexitRisk$ or $Pre-BrexitSentiment$ of firm i, and the vector $X_{i,t}$ always includes the log of the firm's assets as a control for firm size. In some specifications, we further include stock return betas, which are calculated by regressing daily returns for firm i in 2015 on the S&P500 index or on the FTSE100 index during that time (to measure the firm's exposure to the US and the UK capital markets, respectively). We exclude firms from the "Non Classifiable" sector as well as firms with fewer than ten manuscripts in the panel.

Turning attention first to Panel A, which reports the full sample estimates, we find in columns 1-2 a negative coefficient estimate between $\overline{BrexitExposure}$ and asset prices. For a firm with an average post-Brexit vote exposure of UK headquartered firms (i.e., with a value of 1), we find the equity prices drop by 2.6 percent in the course of four trading days. The magnitude of the coefficient remains unchanged after controlling for the (US and UK market) CAPM-betas of the stock, implying that the effect is not explained by differences in the firm's exposure to market-wide risk. We then "decompose" the Brexit exposure into a mean and variance component, i.e., we consider next the relation between $\overline{BrexitRisk}$ and $\overline{BrexitSentiment}$ on the one hand and short-window returns on the other (columns 3-4). We find that higher Brexit risk leads to lower stock returns ($\hat{\beta}$=-0.011, std. err.=0.002),

they expect the firm may be impacted by the event.

[15] We restrict the event study to firms with return data available on CRSP, i.e., to firms (cross)listed in the US.

consistent with the event revising discount rates upward in the cross-section of firms. We do not only find a second moment effect, however. An increase in Brexit sentiment leads to higher stock prices ($\hat{\beta}$=0.002, std. err.=0.001), consistent with the view that firms that are negatively exposed to Brexit significantly lose market valuation immediately after the result of the Brexit referendum becomes known. Once more, our coefficient estimates are unaffected by controlling for CAPM-betas (in column 4).

In the final column, we use the $Pre-BrexitRisk$ and $Pre-BrexitSentiment$ variables to explain the short window price response, in an effort to estimate the market's response using only information that was known at the time of the referendum. In column 5, we find a negative effect of $Pre-BrexitRisk$ on the stock price change (-0.006. std. err.=0.002) At the same time, we find no significant effect of $Pre-BrexitSentiment$ on short window returns, though the sign and size of coefficient is similar to the ones in the prior columns.

We repeat the same analysis in panel B, but now restrict the sample to US listed firms only. Our estimates for the US sample do not deviate meaningfully from what we documented for the full sample. Indeed, the coefficient estimates on $\overline{BrexitExposure}$ are only slightly smaller in columns 1-2 for the US. We find a somewhat stronger stock price response to $\overline{BrexitSentiment}$ and a somewhat weaker response to $\overline{BrexitRisk}$ when we tease out the two components of exposure to Brexit in columns 3-4. Both are statistically significant at the one percent level. Finally, in column 5, we find that, for US listed firms, $Pre-BrexitSentiment$ is significantly positively associated with stock prices changes (at the five percent level), whereas $Pre-BrexitRisk$ continues to be negatively associated with the same, also at the five percent level.

We probe the event study results further in Figure 5, which summarizes graphically the OLS regression estimates of $Pre-BrexitRisk$ (corresponding to column 5 of Panel B in Table 6) onto a sequence of 4-day return windows, centered around the Brexit vote on June 23, 2016. Each event window consists of 4 consecutive trading days, with the "treatment" window stretching from June 24-28, and the remaining event windows distributed in the

period before and after these dates. As the referendum outcome was unexpected, even by the most ardent supporters of the Leave campaign, we should not find a significant $\hat{\beta}$ before the vote. Similarly, if the effects of the leave vote are impounded in asset prices quickly, we should not find a lingering effect after the vote. Indeed, we only find a significant negative coefficient estimate on $Pre - BrexitRisk$ in the treatment window, not before and not afterwards. These results bolster our confidence that the event study estimates for Brexit risk are not inadvertently picking up some other factor and/or event. Importantly, the results also suggest that Brexit was not anticipated and that financial markets reflected the news in prices quickly.

Finally, in Figure 6, we show that we can estimate the asset pricing effect of the Brexit referendum separately for UK and non-UK firms. Indeed, the figure shows two panels of binned added variable plots for $\overline{BrexitRisk}$ and four-trading day returns. The left panel shows the relation for the sample of UK headquartered firms and the right panel is based on the non-UK headquartered firms. The plots are again based on panel regressions controlling for $\overline{BrexitSentiment}$, the log of assets, and sector and time fixed effects. We see a negative relation in both panels, although the slope coefficient is more negative in the UK sample, implying that the pricing response to Brexit uncertainty is negative for both UK and non-UK firms.

3.3. Regional Support for Brexit

The final empirical validation for our Brexit exposure measures builds on a simple intuition. When voters live in a region that also contains the headquarters of a firm with elevated Brexit exposure, they are more likely to cast their vote in the election against leaving the EU. Previous studies have generally focused on voter characteristics (such as age, ethnicity, and educational achievements) to explain geographical variation in voting (Alabrese et al., 2019; Fetzer, 2019). We propose that voters will also be guided in their referendum choice by their assessment how leaving the EU will affect the local economic and employment

conditions. Thus, if local companies find Brexit risky and consider the prospect bad news, we might expect the regional share of the vote in support of Leave to decrease. We test this intuition in Table 7.

We first determine the location of each firm by the area code of its operational headquarters, which we then map into electoral districts (counties). Then, for each county, we compute the county-level $\overline{BrexitRisk_c}$ ($\overline{BrexitSentiment_c}$) by averaging the firm-level $\overline{BrexitRisk_i}$ ($\overline{BrexitSentiment_i}$) across firms in the county. We then estimate cross-sectional regressions of the county-level vote share in support of Leave ($\%leave_c$) onto $\overline{BrexitRisk_c}$, $\overline{BrexitSentiment_c}$, and two demographic controls (share UK born, i.e., the proportion of the population in the county that was born in the UK, and Income per Capita). Specifically,

$$\%leave_c = \alpha + \beta\overline{BrexitRisk_c} + \gamma\overline{BrexitSentiment_c} + X_c'\zeta + \epsilon_c \tag{2}$$

These OLS regressions are estimated using data from 110 counties and inferences are based on robust standard errors. Note that the distribution of sample firms across the UK is clustered geographically. Table 8 in the Data Appendix provides additional detail. Most counties have only a single sample firm, but a few counties (e.g., the City of London and Greater London) house many headquarters.

In column 1, where we only consider county-level $\overline{BrexitRisk_c}$, we find a negative association with the Leave vote share in the referendum. Turning to $\overline{BrexitSentiment_c}$ in column 2, shows that when firms in the county see, on average, Brexit as bad news, the association with the Leave vote share is strongly negative. In the final column, we include both Brexit variables at the same time and find very similar results compared to when we estimate the first and second moment effects in isolation. The estimated coefficients imply that a one standard deviation increase in $\overline{BrexitRisk_c}$ (1.59) is associated with 1.48 percentage point decrease in the percentage of the population that voted leave. Similarly, a one standard deviation decrease in $\overline{BrexitSentiment_c}$ (4.44) accounts for a 1.71 percentage point drop in

support for Brexit.[16] For completeness, note that wealthier counties and counties with larger immigrant (non-UK born) populations have lower support for Leave.

We offer these findings as part of the efforts to validate our Brexit measures; at the same time, however, it is instructive to note that Alabrese et al. (2019) and Fetzer (2019) find substantial *geographical* heterogeneity in the extent to which demographic variables can explain the Brexit vote. Our findings suggest that "spillovers" from local companies might be the source of some of this geographical heterogeneity. This conjecture is further reinforced by Figure 7, which presents an added variable plot of the relation between $\overline{BrexitSentiment_c}$ and the Leave vote share. The plot shows a strong positive association between local Brexit sentiment and the proportion of voters in the county that voted to leave.

4. The Firm-level Effects of Brexit

Two substantive facts emerge from the validation exercise in the previous section. First, firms are exposed to the shock of the Brexit referendum, not just in the UK, but globally, with the shock perhaps felt most strongly in (nearby) EU countries, but extending as far afield as the United States, Singapore, and South Africa. Second, stock markets impound both the first and second moment implications in asset prices quickly, with increases in Brexit risk leading to price drops, while increases in Brexit sentiment (implying Brexit being good news for the firm) leading to price gains in a tight window around the 2016 referendum. While these findings are consistent with the forward-looking properties of equity markets, they also leave open the question of the degree to which individual firm actions respond to the Brexit referendum shock. We therefore estimate the effect of firm-level Brexit risk and sentiment on investments, hiring, productivity, and sales, using the following specification:

$$y_{i,t+1} = \delta_j + \delta_t + \delta_c + \beta BrexitRisk_{i,t} + \theta BrexitSentiment_{i,t} + X_{i,t}^{'}\zeta + \epsilon_{i,t} \tag{3}$$

[16] The partial R^2 of these two variables in column 3 is about 5%.

where $y_{i,t}$ is the firm policy outcome of interest, δ_j, δ_t, and δ_c are industry, year, and headquarter-country fixed effects, respectively, and the vector $X_{i,t}$ always includes the log of the firm's assets as a control for firm size as well as $Non - BrexitRisk$ and $Non - BrexitSentiment$. $BrexitRisk$ and $BrexitSentiment$ are at an annual frequency and computed by averaging over all available earnings call transcripts in a given year. Inferences are based on standard errors clustered at the firm-level. Firm outcomes are measured at the yearly frequency from 2011-2018. Summary statistics on all firm-level variables are presented in Table 5.

It is well-recognized, both in theory and in empirical work, that uncertainty can directly influence firm-level investments and employment (Pindyck, 1988; Bernanke, 1983; Dixit and Pindyck, 1994; Bloom et al., 2007). What's more, recent developments in this literature have highlighted that first and second moment shocks can appear together, and either amplify or confound each other (Bloom et al., 2018; Berger et al., 2017; Hassan et al., 2019). We examine these predictions in the context of Brexit, which has been argued to represent an "almost ideal" uncertainty shock inasmuch as it was large, unanticipated, and was not flanked by other changes (Fisman and Zitzewitz, 2019; Born et al., 2019).[17]

Figure 8 illustrates the approach using a binned added variable plot of firm-level capital investment ($I_{i,t+1}/K_{i,t}$) over $BrexitRisk_{i,t}$, while controlling for $BrexitSentiment_{i,t}$, the log of assets, and sector and time fixed effects. The red line presents the slope estimate for the sample of UK firms, whereas the blue line is fitted to the experience of firms with headquarters outside of the UK. In both panels, $BrexitRisk$ is negatively and significantly associated with the capital investment rate. Indeed, the estimated coefficients are very similar in magnitude (-0.609 (s.e.=0.011) in the UK and -0.670 (s.e.=0.001) in the non-UK sample, respectively). To give some more color to these estimates, the latter coefficient implies that, for each year post 2016, a given international firm with a $BrexitRisk$ equal to

[17]Indeed, Bloom et al. (2019) points out that Brexit presents a persistent uncertainty shock that should have heterogeneous impacts on UK firms depending on their prior exposure to the EU. Moving beyond the impact on UK firms, however, we are able to also estimate the effects of this shock on non-UK firms or even on US firms separately.

that of the average UK firm experiences a 2.6% decrease in its investment rate relative to the mean investment rate in our panel (24.5).

We conduct a more systematic analysis of the relation between the firm's capital investment rate and Brexit risk and sentiment in Table 8. In panel A, we first consider the full sample of UK-based and international firms. Column 1 presents estimates of a base specification with $BrexitRisk_{i,t}$ and $BrexitSentiment_{i,t}$, our variables of interest, and time and sector fixed effects, as well as the log of assets as controls. We find a significant negative association between $BrexitRisk_{i,t}$ and the capital investment rate ($\hat{\theta}$=-0.843, std. err.=0.175). At the same time, we find no significant association between $BrexitSentiment_{i,t}$ and $I_{i,t+1}/K_{i,t}$. We then add an interaction term between $BrexitRisk$ and an indicator variable that takes the value of unity when the firm is headquartered in the UK and zero otherwise, to explore whether the relation between uncertainty and investment is different for UK and non-UK firms (the main effect of UK HQ is negative, insignificant, and not shown to save space). Consistent with Figure 8 we find, however, no statistically reliable evidence for such a difference. That is, for a given exposure to Brexit risk, the elasticity of investment with respect to this Brexit risk is not significantly different for UK and international firms.

In the next two columns, we work towards our preferred specification that controls both for overall (i.e., non-Brexit related) firm-level risk and sentiment (in column 3), as well as sector-by-time and country fixed effects (in column 4). Reassuringly, we find that firms that are exposed to more overall uncertainty (as based on a textual analysis of their earnings call) have lower investment rates. Similarly, firms that have more good news (first moment) shocks, as measured by a earnings call based measure of sentiment, have *higher* investment rates. Turning to our variables of interest, we find that our earlier conclusions regarding Brexit-related risk and sentiment have not changed despite including these controls for overall uncertainty and sentiment. We continue to find a negative association between $BrexitRisk_{i,t}$ and investments, with only a minor attenuation of the estimated coefficient (largest when including the most stringent fixed effects structure in column 4). Indeed, the estimated

effect of $BrexitRisk_{i,t}$ implies that the investments of a firm with Brexit risk equal to that of the average UK firm after the Brexit referendum, decrease by 0.640 percentage points (or 2.6 percent relative to the mean). Extrapolating using the country-specific means from Figure 2, this then implies a 2.6×1.7=4.2 percent decrease for the average Irish firm and a $0.6 \times 2.6 = 1.56$ percent decrease for the average South African firm in our sample.

Columns 5 and 6 are constructed as placebo tests to address potential concerns about the earlier estimates. In column 5, we add the firm's average sales in the UK *before* the Brexit referendum as an additional control variable to our regression. In column 6, we further add a firm-level, time-invariant measure of Brexit exposure calculated across all observations of a given firm in the sample ($\overline{BrexitExposure_i}$). Note that both of these additional control variables are "bad controls" (Angrist and Pischke, 2008) inasmuch as each is itself a potential proxy for Brexit-related risk and/or sentiment and might therefore inappropriately take away explanatory power from our variables of interest. Notwithstanding these econometric concerns, we find little evidence of adding these additional controls changing the tenor of the main findings. Neither the pre-Brexit UK sales or the ($\overline{BrexitExposure_i}$) are significantly associated with the investment rate. In addition, the significance of the estimated coefficient on $BrexitRisk_{i,t}$ is not affected by their inclusion. As for the full sample, so for the firms headquartered in the US. In panel B, we summarize the same sequence of regressions by reporting the coefficient estimates on $BrexitRisk_{i,t}$. Our estimates are somewhat larger than in the full sample, potentially attributable to the fact that firm-level variables may be measured with less error in this more homogeneous sub-sample of firms. Our preferred estimate in column 4 (-1.026, s.e.=0.346) implies that Brexit risk accounts a 0.5% decrease in the investment rate of the average US-based firm for each year post 2016.

Having established a consistent negative association between Brexit risk and the capital investment rate (but not between Brexit sentiment and the same), we now turn to three further firm outcomes, namely employment growth, total factor productivity, and sales growth. In Table 9, we report panel regressions corresponding to our preferred specification in column

4 of Table 8. In all of these regressions, we provide estimates based on the full sample, a sample of non-UK firms, and, separately, a sample of US firms.

Prior work on the economic consequences of uncertainty shocks predicts very similar responses for employment as for investments. In line with these predictions, panel A in Table 9 shows across all three samples a negative association between $BrexitRisk_{i,t}$ and the employment growth rate $\Delta emp_{i,t}/emp_{i,t-1}$. Coefficient estimates vary between $\hat{\theta}$=-0.391 (std. err.=0.179) and -1.272 (std. err.=0.460) (for the full sample and for the US, respectively), where again the point estimate for US-based firms is larger than the one we obtain in the full sample. These estimates imply for firms with the average post-Brexit vote risk of a UK-based firm, a decrease in employment growth of between 0.391 and 1.272 percentage points, corresponding to a 4.5% and a 14.7% decrease relative to the sample mean. As was the case for the capital investment rate, we find no evidence of a significant association between $BrexitSentiment_{i,t}$ and the employment growth rate.As before, the coefficents on $NonBrexitRisk$ and $NonBrexitSentiment$ are statistically significant and have the predicted sign (see Appendix Table 7 for details).

In Panel B, we consider the log of total factor productivity as the dependent variable. Some researchers have argued that preoccupation with a large uncertainty shock may preoccupy managers and thus divert resources away from the efficient management of the firm, lowering the level of its total factor productivity (Baker et al., 2016). Interestingly, we find evidence in support of this hypothesis. Higher Brexit risk, but not sentiment, is indeed negatively associated with productivity. The coefficient estimates are similar across samples, but for the US slightly smaller and estimated with less precision, yielding a statistically insignificant point estimate. However, given that productivity is measured with a lot of error, particularly for international firms, we interpret these findings with due caution.

Finally, we consider sales growth as the firm policy outcome in panel C. While we still find a negative relation between $BrexitRisk_{i,t}$ and sales growth in all sample partitions, the association is no longer significant. This finding is again consistent with the predictions of

the real options literature, which postulates larger short-run effects of risk on hard-to-reverse investments in physical and human capital than on short-run sales growth. In sharp contrast, however, consistent with sales responding more directly to good and bad news events, we find a positive and significant coefficient estimate between $BrexitSentiment_{i,t}$ and sales growth. These first moment effects are perhaps largest in the US sample, where we find a estimated coefficient equal to 0.410 (std. err.=0.167) implying that firms with Brexit sentiment equal to the average UK firm after the referendum vote (-1) have a 0.41 percentage point lower sales growth in each year post 2016.

In Table 10, we probe our investment and employment results further and examine the timing of the effect of Brexit risk on these firm outcome variables. To do so, we regress both the capital investment rate and the employment growth rate onto contemporaneous $BrexitRisk_{i,t}$ and one period lagged $BrexitRisk_{i,t-1}$. We find that investments respond more sluggishly to changes in Brexit risk than does employment. Indeed, firm hiring appears to respond more to concurrent than lagged Brexit risk, while the opposite is true for the investment rate.

5. Conclusion

Assessing the economic impact of specific policy measures, reforms, and other events requires measuring how these events affect the calculations and expectations of decision makers. In this paper, we develop a simple and adaptable text-based method to measure the costs, benefits, and risks that decision makers at thousands of listed firms around the world associate with specific events. Our method offers several helpful features in light of challenges identified in recent research: first, it measures perceptions directly and in real time from earning conference call transcripts, without the need to conduct expensive large-scale surveys. Second, it allows a meaningful distinction between perceived risks, costs, and opportunities associated with a given event, thus separating variation in first and second moments induced by the event. This aspect is particularly interesting in the context of Brexit, where policymakers

have long pointed to potentially detrimental effects of Brexit-related uncertainty, which we can quantify directly. Third, as our application to Brexit shows, not all shocks (fully) play out in a short period of time, but instead present persistent challenges to economic actors. Having a method that allows researchers to measure the over-time variation in a firm's exposure to such a persistent shock is particularly valuable in recognition of recent evidence that the firm's response to these persistent shocks might be very different from the response to shocks that quickly die away (Bloom et al., 2019).

We use our method to assess the extent to which firms across the globe are affected by the outcome of the 2016 UK referendum on leaving the EU. We show that our measures of Brexit exposure, risk, and sentiment behave in an economically meaningful way, underpinning our validity claims. In the process, we document that firms inside and outside the UK overwhelmingly, view Brexit as a "bad news" for their business. Significant cross-country differences in Brexit risk exists, with Ireland's Brexit risk dominating even the UK's; nearby countries in the EU experiencing on average the strongest increase in risk; and Brexit risk having a material impact also in the United States and other non-EU countries. At the firm-level, we find that even apparent "Brexit winners" most often simply point out that they are currently not much affected (yet) by the prospect of the UK leaving the EU. By contrast, many more firms expect Brexit to bring concrete difficulties for their businesses resulting from regulatory divergence, reduced labor mobility, trade access, and the costs of adjusting their operations post-Brexit.

Within the UK, we observe that the geographical variation in the vote share in favor of leaving the EU is correlated with the Brexit exposure of local firms (i.e., firms in the same electoral district). We also find that asset markets quickly impound both the future cash flow consequences of the Brexit vote as well as its impact on the discount rate, as both Brexit sentiment and Brexit risk explain part of the pricing response on international equity markets in the days following the referendum.

While the pricing response on financial markets is consistent with their forward-looking

quality, the firm-level responses to Brexit exposure are so far mostly related to perceived Brexit risk, not to Brexit sentiment. In this sense, as the implementation of the vote to leave the EU is still pending, the bulk of its effect might yet have to materialize. All we have witnessed so far, in terms of firms significantly reducing investments and hiring, is based on their assessment of uncertainty, rather than being a response to the shock to the first moment (which has yet to be realized).

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Table 1: Data Coverage

	Number of Sample Firms	
	UK headquarters	UK subsidiary
Panel A: By country group		
UK	396	NA
EU non-UK	971	432
US	3,791	1,633
Rest of the world	2,575	776
Panel B: By country		
USA	3,791	1,633
Canada	546	155
UK	396	NA
Australia	321	105
India	270	65
China	181	24
Japan	153	95
Germany	150	79
Sweden	147	40
Brazil	139	17
France	130	77
Switzerland	98	51
Hong Kong	77	28
Netherlands	76	40
Italy	75	35
South Africa	74	36
Norway	68	23
Mexico	68	7
Bermuda	63	40
Israel	61	28
Spain	61	29
Ireland	53	32
Denmark	50	24
Finland	45	19
Singapore	41	11
Russia	41	2
New Zealand	39	5
S. Korea	34	14
Luxembourg	34	12
Taiwan	33	11
Belgium	31	9
Austria	31	15
Poland	28	6
Chile	25	3
Turkey	23	7
Thailand	21	5
Greece	20	1
Malaysia	18	5
Argentina	17	0
Philippines	15	4
Colombia	15	2
Indonesia	15	1
UK Channel Islands	15	6
Cyprus	14	4
United Arab Emirates	14	5
Nigeria	12	5
Cayman Islands	11	3
Peru	10	0
Monaco	10	1
Portugal	9	4
Czech Republic	6	2
Puerto Rico	5	0

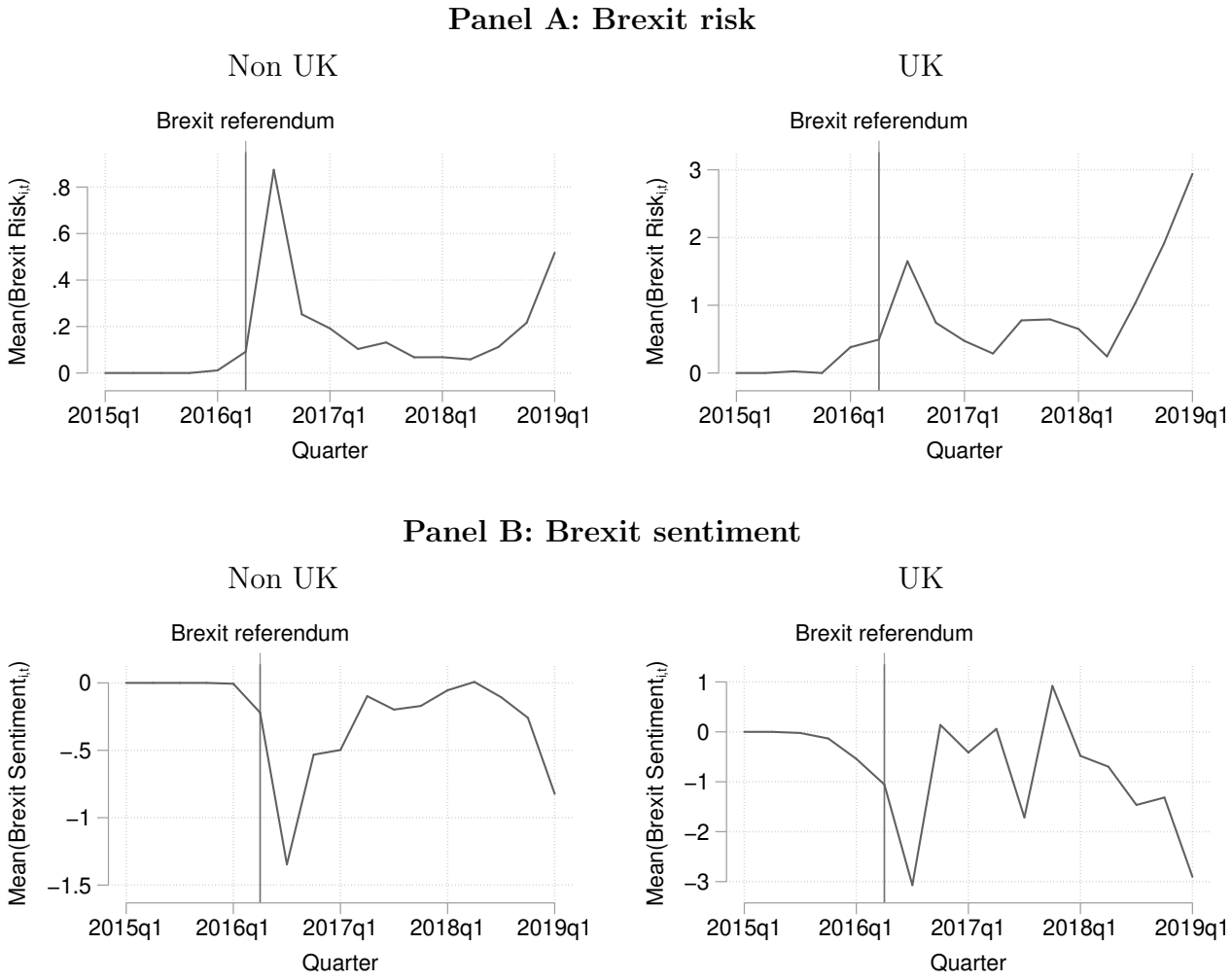
This table reports the number of sample firms headquartered in the UK (left) and with one or more subsidiaries in the UK (right). Panel A splits the sample by country group. Panel B by country (with at least five sample firms headquartered in that country).

Table 2: Validation of BrexitExposure

	$\overline{\text{BrexitExposure}}_i$			
	(1)	(2)	(3)	(4)
{1}{UK HQ}	0.872***	0.909***	0.064	0.116
	(0.075)	(0.075)	(0.088)	(0.092)
{1}{UK subsidiary}	0.188***	0.200***	0.227***	0.227***
	(0.017)	(0.017)	(0.022)	(0.021)
{1}{EU non-UK HQ}		0.263***	0.073	0.072
		(0.032)	(0.087)	(0.084)
% of sales in UK (2010-2015)			1.842***	
			(0.405)	
% of sales in UK (2016-present)				1.766***
				(0.403)
R^2	0.086	0.103	0.120	0.121
N	7,733	7,733	3,497	3,678

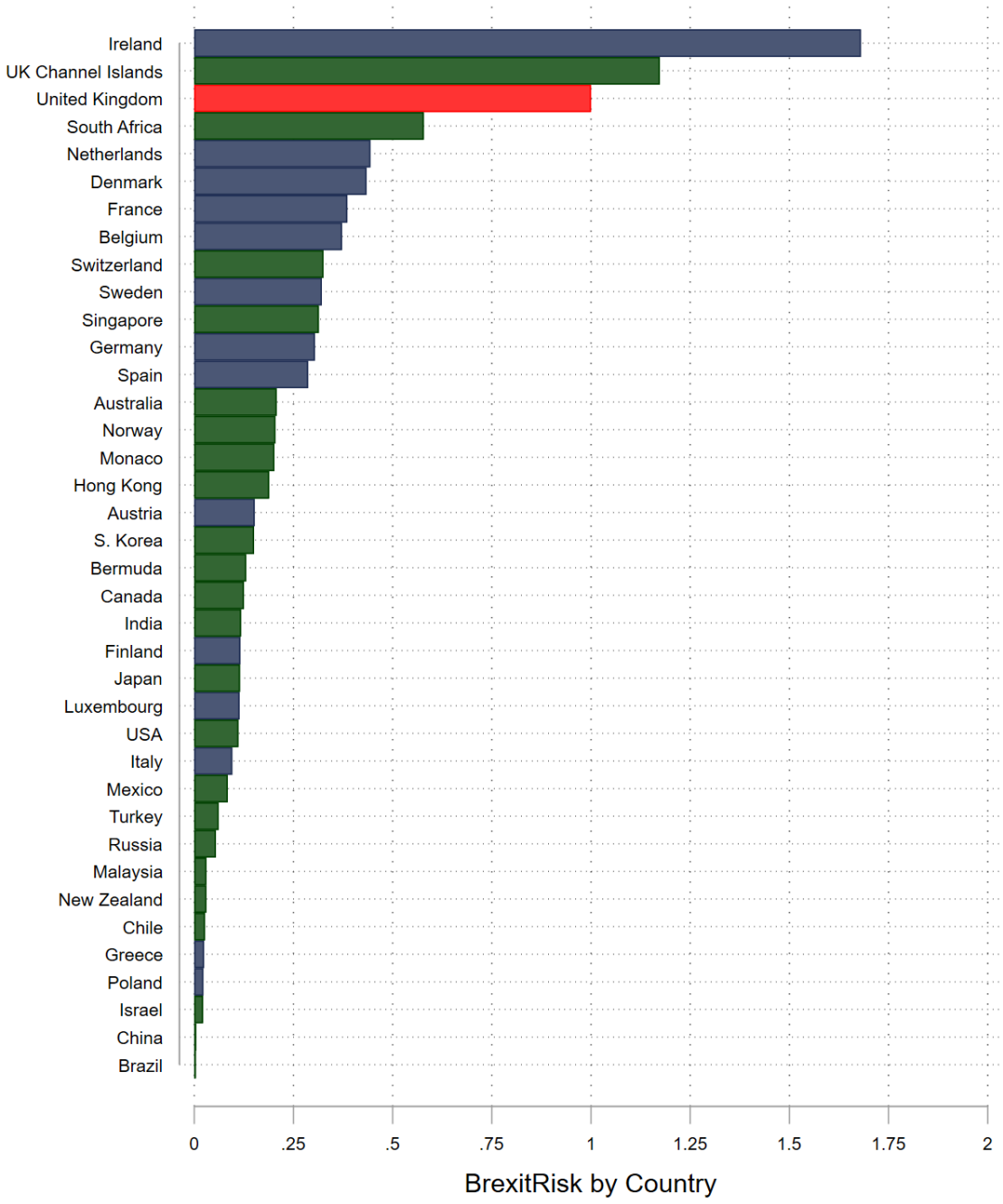
This table reports estimates from cross-sectional regressions using $\overline{\text{BrexitExposure}}_i$ as dependent variable. The number of transcripts, of earnings calls held between 2015Q1 and 2019Q1, used to calculate firm level mean Brexit exposure is 85,468 for 8,149 unique sample firms. Standard errors are robust.

Figure 1: Time Series of BrexitRisk and BrexitSentiment



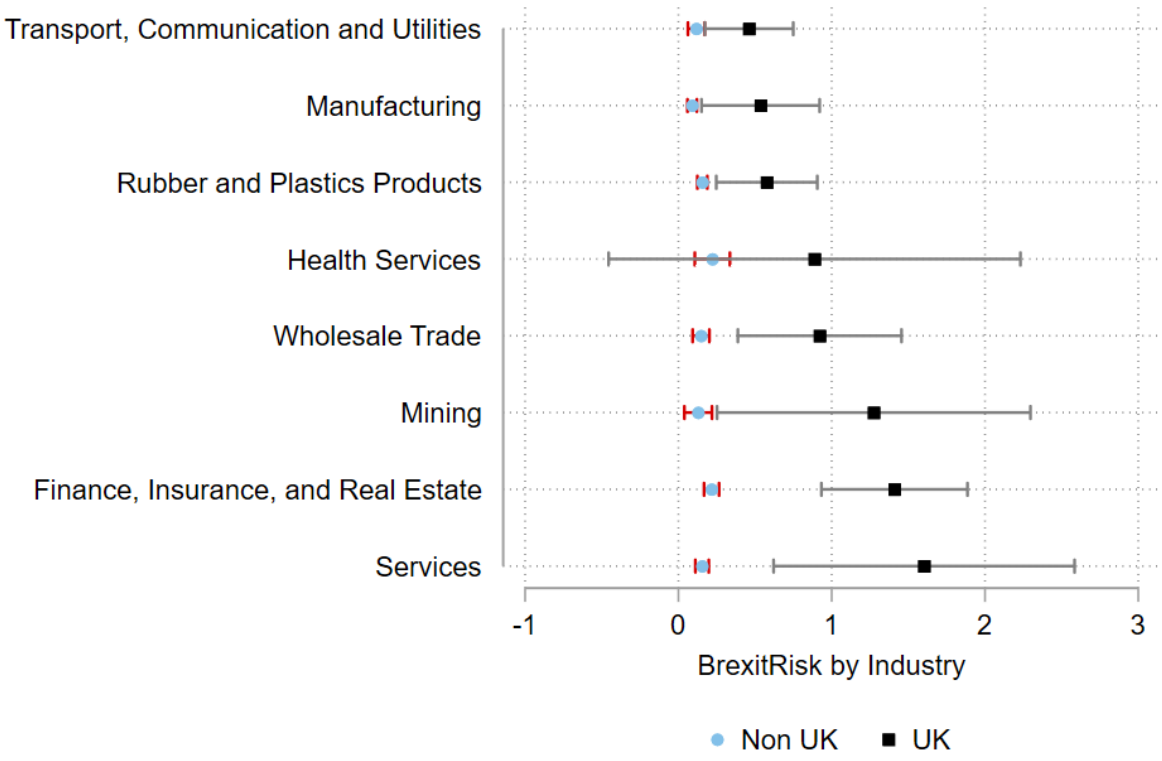
The figure plots time series for Brexit risk (Panel A) and Brexit sentiment (Panel B) for non-UK and UK headquartered firms. Time series are plotted on a quarterly level calculating averages for firms headquartered in respective country groups. $\overline{\text{BrexitRisk}}_i$ for firms is normalized using average $\overline{\text{BrexitRisk}}_i$ of UK-headquartered firms. The number of transcripts, of earning calls held between 2015Q1 and 2019Q1, used in the analysis is 85,468 for 8,149 unique sample firms.

Figure 2: Mean BrexitRisk by Country



Countries included have at least 5 sample firms headquartered in that country and non-zero BrexitRisk. Zero BrexitRisk countries: Puerto Rico, Thailand, Cayman Islands, Portugal, Indonesia, Cyprus, Nigeria, Czech Republic, United Arab Emirates, Argentina, Peru, Phillipines, Columbia. Country level values are calculated by taking the average over all firms headquartered in a country.

Figure 3: BrexitRisk by Industry



The figure shows average BrexitRisk by 1-digit SIC industry for UK and non-UK firms. The confidence intervals around the means are calculated as $\{\overline{\text{BrexitRisk}}_i - t_{N-1}\frac{\sigma}{\sqrt{N}}, \overline{\text{BrexitRisk}}_i + t_{N-1}\frac{\sigma}{\sqrt{N}}\}$ where σ is the standard deviation, N is the number of firms in the industry group, and t_{N-1} is t-stat with $N-1$ degrees of freedom.

Table 3: Top BrexitRisk Firms' Transcript Excerpts

Panel A: UK firms

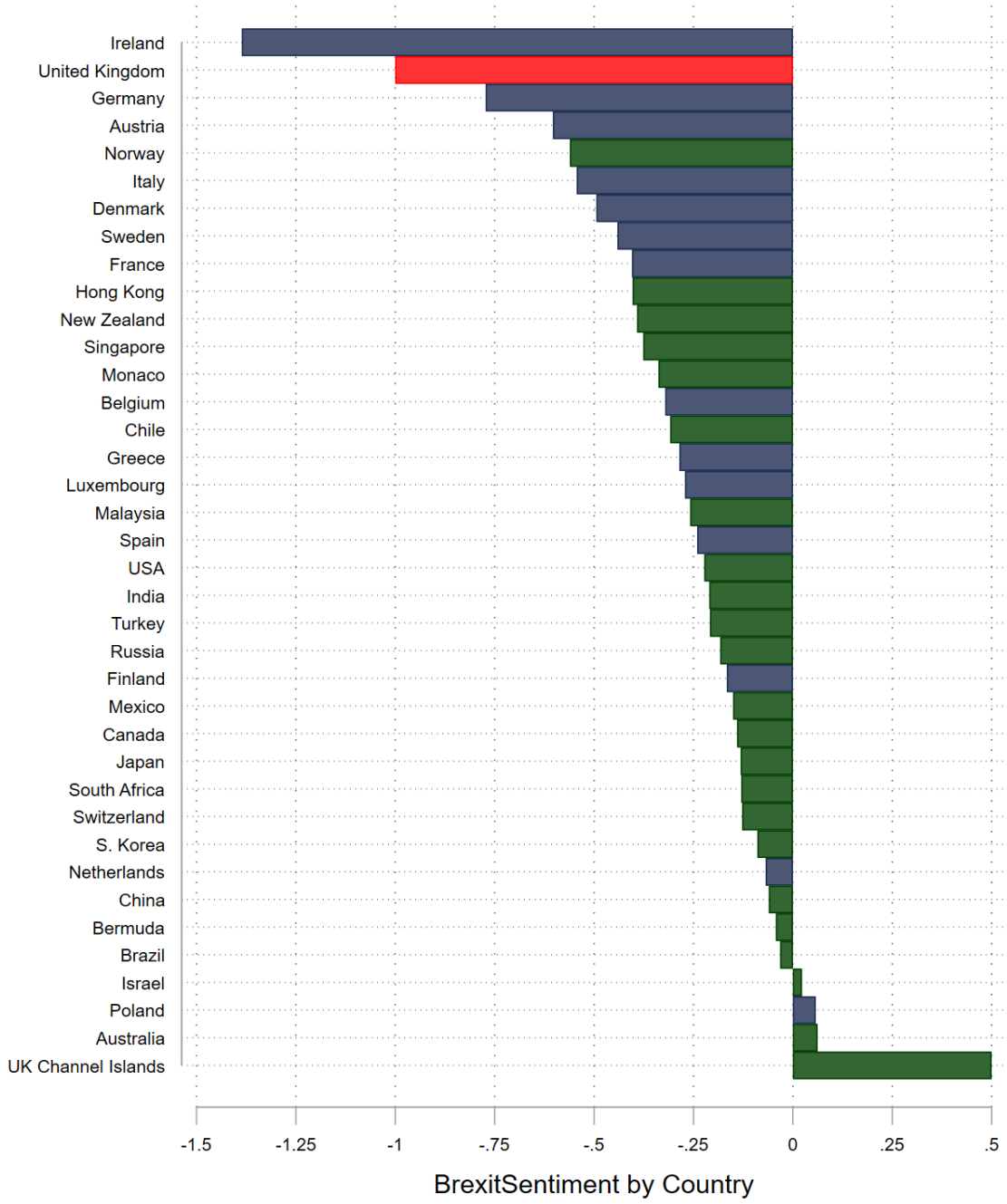
Company	$\overline{\text{BrexitRisk}}_i$	Country	Month	Transcript excerpts
Bellway PLC	18.89	GB	2018-10	deliver completions in fy we are mindful of the **uncertainty** surrounding **brexit** and we will wait to see whether customer sentiment is affected
Berendsen Ltd	14.14	GB	2016-07	and we have i think a pretty proven resilient business however **brexit** raises any number of **uncertainties** for every single business so were
SThree PLC	13.64	GB	2019-01	year theres also a lot of **uncertainty** around the uk and **brexit** and that will affect most markets but i think again the
Endava PLC	12.9	GB	2019-01	plans with us as a result of the **uncertainties** caused by **brexit** mark will talk about how weve mitigated fx **risk** in his
Millennium & Copthorne Hotels PLC	10.48	GB	2018-01	as you know there is still **uncertainty** about british economy and **brexit** for example we are seeing a rise in costs here because

Panel B: Non-UK firms

Company	$\overline{\text{BrexitRisk}}_i$	Country	Month	Transcript excerpts
Northstar Realty Europe Corp	18.35	US	2016-07	give rise to greater **uncertainty** this **uncertainty** has been exasperated by **brexit** the **prospect** of **brexit** has resulted in a high degree of
Ryanair Holdings PLC	18.29	IE	2017	airlines the pricing environment has also been affected by the post **brexit uncertainty** which has seen weaker sterling and a switch of charter
Breedon Group PLC	17.58	JE	2019-01	quarter and the increased input costs but also an element of **brexit** uncertainty in ireland our performance was strong and benefited from the
Sweco AB (publ)	12.58	SE	2018-10	but still there is still an **uncertainty** when it comes to **brexit** and some weakness in the real estate market so once again
Stonegate Mortgage Corp	11.65	US	2016-07	markets primarily driven by economic concerns abroad in particular **uncertainty** around **brexit** played a major role related to the **instability** of interest rates
FBD Holdings PLC	10.76	IE	2019-01	our agri and agribusiness customers are very **exposed** to a hard **brexit** and any contingency planning that we can do and we have
Nanosonics Ltd	9.9	AU	2019-01	this in the uk but there is some underlying **uncertainty** around **brexit** with the likes of confirmation of product supply chain questionnaires that
Bank of Ireland Group PLC	9.18	IE	2019-01	of the sme market continues to be impacted by the ongoing **brexit uncertainties** our corporate banking business which includes property lending had a
Cairn Homes PLC	8.75	IE	2019-01	enjoys we are all faced with **uncertainty** with the **uncertainty** which **brexit** brings from a cairn perspective our operations are currently all focused
EQT Holdings Ltd	8.58	AU	2019-01	about **brexit** and whether the **uncertainty** being driven by the ultimate **brexit** solution and the timing of that is causing an issue for

The table shows transcript excerpts for top 5 UK and top 10 non-UK firms ranked on a firm's $\overline{\text{BrexitRisk}}_i$ calculated using all its available transcripts of earnings calls held from 2016 to 2019.

Figure 4: Mean BrexitSentiment by Country



Countries included have at least 5 sample firms headquartered in that country. Zero BrexitRisk countries: Puerto Rico, Thailand, Cayman Islands, Portugal, Indonesia, Cyprus, Nigeria, Czech Republic, United Arab Emirates, Argentina, Peru, Phillipines, Columbia. Country level values are calculated by taking the average over all firms headquartered in a country. UK Channel Islands has a BrexitSentiment value of 2, and has been truncated at 0.5 for representation purposes.

Table 4: Brexit-related Concerns and Opportunities expressed by Management

Panel A: Positive Brexit sentiment

Category	UK	Non-UK	Transcript excerpt
Not exposed	81.82	81.48	**despite** whats going on with the **brexit** noise so thus far we havent seen a whole lot of softening and just to remind you our uk office portfolio we have no financial institution exposure (Kennedy-Wilson Holdings Inc, US, 2019 Q1)
Weak pound	18.18	17.59	saw a spike in leisure occupancy after the **brexit** referendum in june as tourists took **advantage** of the cheaper pound (Millennium & Copthorne Hotels PLC, UK, 2017 Q1)
Relocation opportunities	4.55	2.78	potential **opportunity** coming from **brexit** and weve seen a number of firms announcing that frankfurt would ultimately be their european hub (Deutsche Boerse AG, DE, 2017 Q3)
Higher government expenditure	0	1.85	probably greater amount of private capital going into those assets simply because of the other pressures on government spending so i think **brexit** is neutral to who knows maybe mildly **positive** for us (International Public Partnerships Ltd, GG, 2016 Q3)
Better trade access	0	1.85	brexit could be **beneficial** for forfarmers i can understand that it might have a **positive** impact on your position in the uk (ForFarmers, NL, 2019 Q1)
Less regulation	0	0	NA

Panel B: Negative Brexit sentiment

Category	UK	Non-UK	Transcript excerpt
Weak pound	47.06	60.69	on the cost side weve had some cost headwinds fx particularly as sterling has still been **weaker** this year than last after **brexit** has impacted us (Flybe Group PLC, UK, 2018 Q2)
Adjustment and transition costs	17.65	0.69	gbp million related to our investment in our operating platform regulatory developments and **brexit** preparations (Jupiter Fund Management PLC, UK, 2019 Q1)
New, multiple regulatory regimes	11.76	10.34	i sincerely hope that for the implementation of the brexit reasonable solutions will be found that will preserve to a large extent the rules of the single market for energy (Yunipro PAO, RU, 2016 Q3)
Labor market frictions	11.76	8.97	labor market is getting tighter **brexit** will bring additional **challenges** with regard to particularly experienced people within all over banking organizations in ireland (Permanent TSB Group Holdings PLC, IE, 2018 Q3)
Worse trade access	5.88	26.21	if the uk is **unable** to negotiate access to the single market or open skies it may have implications for our three uk domestic routes (Ryan Air Holdings, IE, 2016 Q3)
Falling consumer confidence	5.88	1.38	**brexit** has been and will continue to be a significant focus for the industry over the coming months we will be **affected** by the outcomes to the extent that there is significant changes in consumer confidence (Auto Trader Group PLC, UK, 2018 Q4)

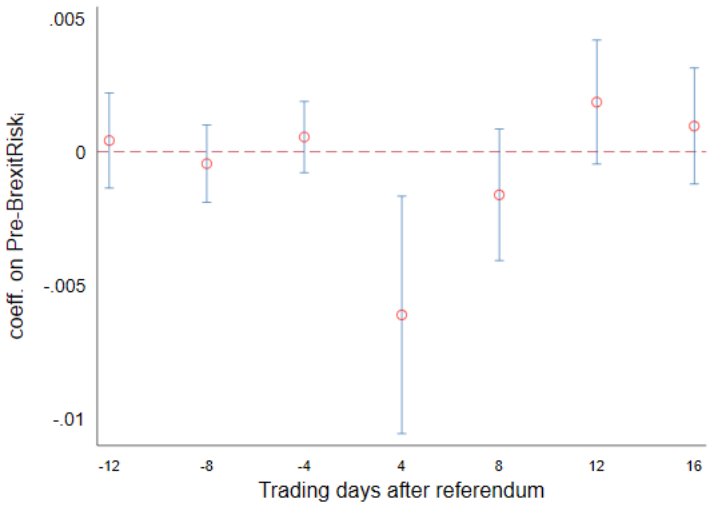
We manually classified positive (Panel A) and negative (Panel B) Brexit sentiment excerpts (+/- 10 words around sentiment word) into predefined categories. This table reports a breakdown per category. We classified snippets from the top 100 positive and negative BrexitSentiment firms. We classified 128 out of total 349 positive sentiment excerpts, and 162 out of total 549 negative sentiment excerpts. Left over excerpts did not have an intersecting theme with any of the mentioned categories. Numbers in the columns 'UK' and 'Non-UK' denote percentages out of classified excerpts.

Table 5: Summary Statistics

	All firms			UK firms		Non-UK firms		Total
	Mean	Median	SD	Mean	SD	Mean	SD	N
Firm-level risk and sentiment (2016 onward)								
$\overline{\text{BrexitExposure}_i}$	0.211	0.000	0.674	1.000	1.496	0.169	0.568	7,733
$\overline{\text{BrexitRisk}_i}$	0.195	0.000	0.931	1.000	2.287	0.152	0.771	7,733
$\overline{\text{BrexitSentiment}_i}$	-0.255	0.000	2.104	-1.000	4.196	-0.215	1.920	7,733
Event study variables								
$\text{Pre-BrexitExposure}_i$	0.037	0.000	0.304	0.281	0.782	0.029	0.274	3,907
Pre-BrexitRisk_i	0.032	0.000	0.441	0.173	1.199	0.028	0.395	3,907
$\text{Pre-BrexitSentiment}_i$	-0.048	0.000	1.087	-0.131	2.121	-0.045	1.040	3,907
Stock Returns_i: June 24-28, 2016	-0.034	-0.030	0.066	-0.096	0.096	-0.032	0.064	4,691
County level variables								
$\text{Pct Votes for Leave}_c$	48.816	50.769	11.334	NA	NA	NA	NA	116
Brexit Risk_c	1.000	0.375	1.585	NA	NA	NA	NA	116
$\text{Brexit Sentiment}_c$	-1.000	-0.065	4.442	NA	NA	NA	NA	116
Firm-year outcomes (2011-2018)								
$\text{BrexitExposure}_{i,t}$	0.083	0.000	0.502	0.414	1.216	0.067	0.433	44,665
$\text{BrexitRisk}_{i,t}$	0.060	0.000	0.619	0.300	1.620	0.049	0.522	44,665
$\text{BrexitSentiment}_{i,t}$	-0.088	0.000	1.822	-0.351	4.215	-0.075	1.618	44,665
$\text{Non-BrexitRisk}_{i,t}$	69.076	59.037	43.277	56.999	33.664	69.660	43.604	44,665
$\text{Non-BrexitSentiment}_{i,t}$	646.250	656.221	510.038	841.494	471.875	636.809	509.925	44,665
$I_{i,t+1}/K_{i,t} \cdot 100$	24.208	14.250	40.369	19.568	31.431	24.449	40.765	43,863
$\Delta emp_{i,t}/emp_{i,t-1} \cdot 100$	8.168	2.941	29.492	6.853	27.155	8.240	29.613	47,713
$\Delta sales_{i,t}/sales_{i,t-1} \cdot 100$	17.452	6.538	70.393	11.069	47.544	17.766	71.314	55,402
$log(TFP)_{i,t}$	2.203	2.026	1.892	1.684	1.697	2.225	1.897	11,355

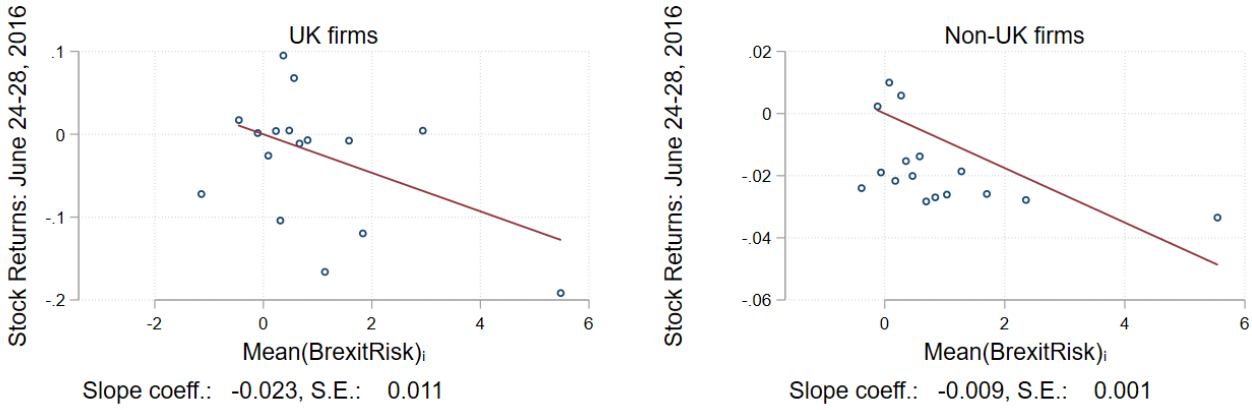
$\overline{\text{BrexitRisk}}_i$ and $\overline{\text{BrexitSentiment}}_i$ at the firm level for cross-sectional regressions are calculated starting January 1, 2016 to December 31, 2018, and are normalized by $\overline{\text{BrexitRisk}}_i$ and $\overline{\text{BrexitSentiment}}_i$ for UK headquartered firms post January 1, 2016. $\overline{\text{BrexitRisk}}_c$ and $\overline{\text{BrexitSentiment}}_c$ for county level variables are constructed by taking a mean for every firm, and then averaging over all firms headquartered in an area code. Both are normalized by the $\overline{\text{BrexitRisk}}_c$ and $\overline{\text{BrexitSentiment}}_c$ for all areas in the UK. For firm outcomes, t is at yearly frequency. The sample period for yearly outcomes is 2011-2018.

Figure 5: Alternative Event Windows around Referendum



The figures above show 95% confidence intervals of the coefficient estimated on Pre-BrexitRisk$_i$ for 3 consecutive event windows around the referendum in 2016 for the specification in Table 6 Column 5. Each event window consists of 4 consecutive trading days.

Figure 6: Effect of Brexit Risk on Stock Returns



The figures show bin scatter plots (separately for UK (left panel) and non-UK (right panel)) for regressions of Stock Returns: June 24-28, 2016 on $\overline{\text{BrexitRisk}_i}$ controlling for $\overline{\text{Brexit Sentiment}_i}$, log(assets), and 1-digit SIC and country fixed effects. Standard errors are clustered by firm. Each scatter plot has 16 bins: the first bin is for all firm-year observations with zero $\overline{\text{BrexitRisk}_i}$, and the rest of the 15 bins are equally populated for firm-year observations with non-zero $\overline{\text{BrexitRisk}_i}$.

Table 6: Event Study

	Stock Returns: June 24-28 2016				
	(1)	(2)	(3)	(4)	(5)
Panel A:	All firms				
$\overline{\text{BrexitExposure}_i}$	–0.026***	–0.026***			
	(0.003)	(0.003)			
$\overline{\text{BrexitRisk}_i}$			–0.011***	–0.011***	
			(0.002)	(0.002)	
$\overline{\text{BrexitSentiment}_i}$			0.002**	0.002**	
			(0.001)	(0.001)	
Pre-BrexitRisk$_i$					–0.006***
					(0.002)
Pre-BrexitSentiment$_i$					0.001
					(0.001)
Constant	–0.008*	0.003	–0.007	0.005	0.005
	(0.004)	(0.005)	(0.005)	(0.005)	(0.006)
R^2	0.156	0.192	0.140	0.175	0.170
N	3,875	3,834	3,875	3,834	3,422
Panel B:	US firms				
$\overline{\text{BrexitExposure}_i}$	–0.024***	–0.023***			
	(0.003)	(0.002)			
$\overline{\text{BrexitRisk}_i}$			–0.008***	–0.007***	
			(0.001)	(0.002)	
$\overline{\text{BrexitSentiment}_i}$			0.004***	0.004***	
			(0.001)	(0.001)	
Pre-BrexitRisk$_i$					–0.005**
					(0.002)
Pre-BrexitSentiment$_i$					0.002**
					(0.001)
Constant	–0.009*	0.009	–0.007	0.010*	0.010*
	(0.005)	(0.006)	(0.005)	(0.006)	(0.006)
R^2	0.067	0.124	0.059	0.116	0.118
N	2,806	2,777	2,806	2,777	2,531
Beta Controls	N	Y	N	Y	Y

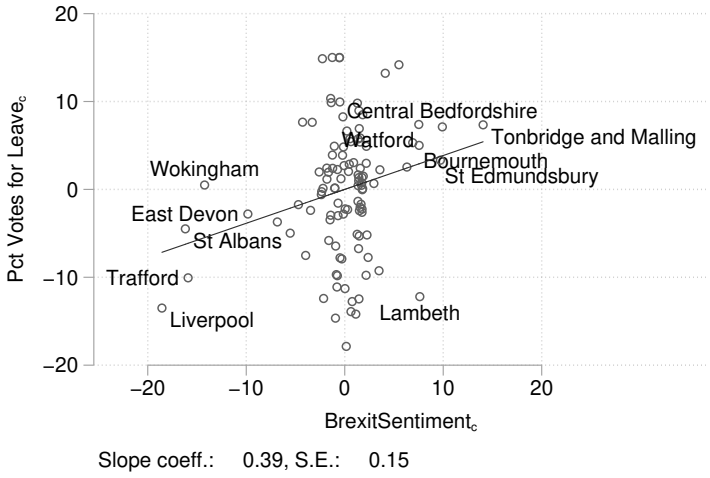
This table reports results from cross sectional regressions of stock returns on $\overline{\text{BrexitRisk}_i}$ and $\overline{\text{Brexit Sentiment}_i}$, (separately for all firms (panel A) and US headquartered firms (panel B). Stock returns are calculated as $\sum_{t=0}^{t=N} log(P_{i,t}/P_{i,t-1})$, where t is at a daily frequency, and [0,N] represents the following period after the Brexit referendum: starting on June 24, 2016 and ending on June 29, 2016 (4 trading days including weekend days). The regressions exclude non-UK firms with less than 7 transcripts in the sample, and firms in the 'Non Classifiable' sectors. All specifications include 1-digit SIC fixed effects and headquarters country fixed effects (with the exception of Panel B). Standard errors are clustered by firm. Betas for the US and the UK have been calculated by regressing daily returns for firm i in 2015, on respective country market indices during that time.

Table 7: Voting in Brexit Referendum

	% leave		
	(1)	(2)	(3)
BrexitRisk_c	–0.838*		–0.929**
	(0.456)		(0.378)
BrexitSentiment_c		0.358***	0.386***
		(0.133)	(0.114)
Share UK born	50.481***	51.592***	52.395***
	(7.296)	(7.484)	(7.380)
Income per capita	–0.024***	–0.022***	–0.023***
	(0.004)	(0.003)	(0.004)
R^2	0.580	0.586	0.604
N	110	110	110

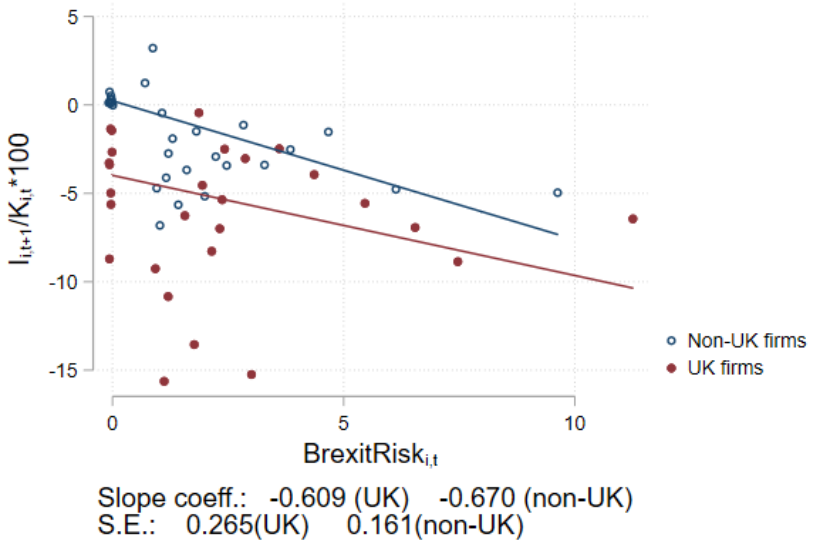
This table reports estimates from crosssectional regressions of Pct Vote for Leave on BrexitRisk_c and Brexit Sentiment_c. The latter two variables are constructed by taking the mean for every firm, and then by averaging over all firms headquartered in a county. The number of transcripts, of earnings calls held between 2015- Q1 and 2019-Q1, used to calculate firm-level means is 2,945, for 407 unique sample firms. Standard errors are robust.

Figure 7: Voting in Brexit Referendum Table 7 Column 3



The figure presents an added variable plot for specification in Column 3 from Table 7. The areas labeled are those observations with a residual value larger than 1.6 standard deviations times the sample mean.

Figure 8: BrexitRisk$_{i,t}$ and Firm Investment



The figure shows bin scatter plots for panel regressions of $I_{i,t+1}/K_{i,t}$· 100 on BrexitRisk$_{i,t}$ separately for UK firms (red) and non-UK firms (blue), controlling for log(assets), 1-digit SIC and year fixed effects. Standard errors are clustered by firm. Scatter plot has 29 bins for UK firms and non-UK firms: the first 9 bins for all firm-year observations with zero BrexitRisk$_{i,t}$ grouped by 9 1-digit SIC codes, and rest of the 20 bins are equally populated for firm-year observations with non-zero BrexitRisk$_{i,t}$.

Table 8: $\text{BrexitRisk}_{i,t}$, $\text{BrexitSentiment}_{i,t}$, and Firm Investment

	$I_{i,t+1}/K_{i,t} \cdot 100$					
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A	All firms					
$\text{BrexitRisk}_{i,t}$	–0.843***	–0.788***	–0.858***	–0.640***	–0.686***	–0.978***
	(0.175)	(0.190)	(0.176)	(0.184)	(0.206)	(0.287)
$\text{BrexitSentiment}_{i,t}$	–0.115	–0.117	–0.122	–0.115	–0.113*	–0.045
	(0.094)	(0.093)	(0.094)	(0.097)	(0.067)	(0.080)
$\text{BrexitRisk}_{i,t} \times \mathbb{1}\{\text{UK HQ}\}$		0.093				
		(0.331)				
$\text{Non-BrexitRisk}_{i,t}$			–0.012**	–0.018***	–0.029***	–0.029***
			(0.005)	(0.006)	(0.009)	(0.009)
$\text{Non-BrexitSentiment}_{i,t}$			0.002***	0.002***	0.003***	0.003***
			(0.000)	(0.001)	(0.001)	(0.001)
Average UK sales_i (pre-Brexit)					1.476	–0.534
					(4.302)	(4.377)
$\overline{\text{BrexitExposure}_i}$						3.103
						(2.383)
R^2	0.034	0.035	0.036	0.070	0.097	0.097
N	22,225	22,225	22,225	22,204	15,301	15,301
Year FE	Y	Y	Y	Y	Y	Y
SIC FE	Y	Y	Y	Y	Y	Y
SIC x year FE	N	N	N	Y	Y	Y
Country FE	N	N	N	Y	Y	Y
Panel B	US firms					
$\text{BrexitRisk}_{i,t}$	–1.089***	–1.089***	–1.027***	–1.026***	–0.754***	–1.238***
	(0.344)	(0.344)	(0.346)	(0.344)	(0.255)	(0.366)
R^2	0.042	0.042	0.044	0.072	0.091	0.092
N	14,219	14,219	14,219	14,198	12,265	12,265
Year FE	Y	Y	Y	Y	Y	Y
SIC FE	Y	Y	Y	Y	Y	Y
SIC x year FE	N	N	N	Y	Y	Y

This table reports results from sensitivity regressions of $I_{i,t+1}/K_{i,t} \cdot 100$ on $\text{BrexitRisk}_{i,t}$ and Brexit $\text{Sentiment}_{i,t}$ using yearly data, separately for the full sample (Panel A) and sample firms headquartered in the US (Panel B). The regressions exclude non-UK firms with less than 10 transcripts in 2015-2018, and firms in the 'Non Classifiable' sectors. $\text{BrexitRisk}_{i,t}$ and Brexit $\text{Sentiment}_{i,t}$ are calculated by taking the yearly average across a firm's quarterly earnings call transcripts held in that year. All specifications control for log(assets) and standard errors are clustered by firm. Specifications control for year, 2-digit SIC, and country (not in the Panel B specifications) fixed effects. The dependent variable is winsorized at the 1st and 99th percentile.

Table 9: $\text{BrexitRisk}_{i,t}$, $\text{BrexitSentiment}_{i,t}$, and Other Firm Outcomes

Panel A	$\Delta emp_{i,t}/emp_{i,t-1} \cdot 100$		
	All	Non-UK	US
$\text{BrexitRisk}_{i,t}$	–0.391**	–0.705**	–1.272***
	(0.179)	(0.276)	(0.460)
$\text{BrexitSentiment}_{i,t}$	–0.011	–0.106	–0.197
	(0.082)	(0.117)	(0.207)
R^2	0.052	0.054	0.057
N	27,141	25,554	18,099
Panel B	$log(TFPR_{i,t})$		
	All	Non-UK	US
$\text{BrexitRisk}_{i,t}$	–0.123***	–0.134***	–0.101
	(0.042)	(0.050)	(0.069)
$\text{BrexitSentiment}_{i,t}$	–0.013	–0.016	0.001
	(0.013)	(0.015)	(0.021)
R^2	0.540	0.535	0.460
N	6,433	6,148	4,327
Panel C	$\Delta sales_{i,t}/sales_{i,t-1} \cdot 100$		
	All	Non-UK	US
$\text{BrexitRisk}_{i,t}$	–0.135	–0.131	–0.096
	(0.251)	(0.372)	(0.591)
$\text{BrexitSentiment}_{i,t}$	0.135*	0.193*	0.410**
	(0.081)	(0.110)	(0.167)
R^2	0.052	0.053	0.058
N	29,042	27,428	18,828

This table reports results from panel regressions of $\Delta emp_{i,t}/emp_{i,t-1} \cdot 100$ (panel A), $log(TFPR_{i,t})$ (panel B), and $\Delta sales_{i,t}/sales_{i,t-1} \cdot 100$ (panel C) on . $\text{BrexitRisk}_{i,t}$ and Brexit $\text{Sentiment}_{i,t}$ are calculated by taking the yearly average across a firm's quarterly earnings call transcripts held in that year. All specifications control for log(assets), and year, 2-digit SIC and country fixed effects. The regressions exclude non-UK firms with less than 10 transcripts in 2015-2018, and firms in the 'Non Classifiable' sectors. Standard errors are clustered by firm. Note that manufacturing shares from the NBER CES dataset are only available till 2011; therefore, for calculating TFPR we take average share for each industry from 2002-2011.

Table 10: Timing of the Effect of Brexit Risk

	$I_{i,t}/K_{i,t-1} \cdot 100$	$\Delta emp_{i,t}/emp_{i,t-1} \cdot 100$
	(1)	(2)
$\text{BrexitRisk}_{i,t}$	–0.251	–0.509**
	(0.156)	(0.210)
$\text{BrexitRisk}_{i,t-1}$	–0.471***	–0.172
	(0.150)	(0.238)
R^2	0.072	0.047
N	21,449	22,698

The table reports estimates from panel regressions using yearly data. In all specifications, we control for log(assets), 2-digit SIC-year and country fixed effects. The regressions exclude non-UK firms with less than 10 transcripts in 2015-2018, and firms in the 'Non Classifiable' sectors.

Online Appendix

to

"The Global Impact of Brexit Uncertainty"

by

Tarek A. Hassan, Stephan Hollander, Laurence van Lent, and Ahmed Tahoun

Data Appendix

Appendix Table 1: Most Frequent Risk Words

Word	Frequency	Word	Frequency
uncertainty	1,157	prospect	4
uncertainties	260	unsure	3
risk	205	bet	3
uncertain	96	insecurity	3
risks	77	risky	3
unknown	33	danger	3
possibility	26	faltering	2
exposed	23	dilemma	2
instability	20	probability	2
threat	17	indecision	2
pending	17	suspicion	2
doubt	16	hesitant	2
fear	16	unpredictability	2
unclear	14	unstable	2
unresolved	13	sticky	1
chance	12	venture	1
likelihood	7	fluctuating	1
unsettled	6	hesitating	1
unpredictable	6	reservation	1
variable	5	speculative	1

This table shows the frequency across all transcripts of all single-word synonyms of "risk," "risky," "uncertain," and "uncertainty" as given in the Oxford Dictionary (excluding "question" and "questions") that appear within 10 words of "Brexit".

Appendix Table 2: Most Frequent Positive Tone Words

Word	Frequency	Word	Frequency
despite	250	improvement	23
good	231	greater	23
strong	170	profitability	23
positive	162	benefited	23
opportunities	99	improving	23
great	98	stability	20
opportunity	70	improve	19
better	67	optimistic	19
stable	65	advantage	16
able	55	favorable	14
benefit	49	stabilize	13
leading	48	rebound	13
confident	37	strengthening	12
progress	35	gain	11
pleased	33	successful	11
improved	31	tremendous	11
gains	29	excellent	11
stronger	28	successfully	9
strength	26	achieve	9
best	24	stabilized	9

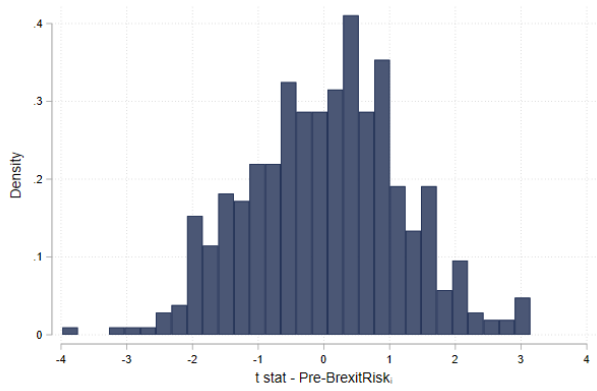
This table shows the frequency across all transcripts of all positive words from Loughran and McDonald (2011) that appear within 10 words of "Brexit".

Appendix Table 3: Most Frequent Negative Tone Words

Word	Frequency	Word	Frequency
volatility	297	negatively	40
concerns	220	slowing	39
negative	182	adverse	38
difficult	102	aftermath	37
challenges	99	unexpected	37
slowdown	99	turmoil	35
decline	85	slower	35
concerned	85	slowed	32
concern	84	shutdown	31
against	74	challenge	31
weakness	74	crisis	30
disruption	72	fears	29
weak	63	delays	26
weaker	63	weakened	25
slow	50	problems	25
late	49	delay	24
weakening	47	caution	23
challenging	43	delayed	23
volatile	43	exposed	23
fallout	42	recall	22

This table shows the frequency across all transcripts of all negative words from Loughran and McDonald (2011), excluding "question", "questions", and "ill" that appear within 10 words of "Brexit".

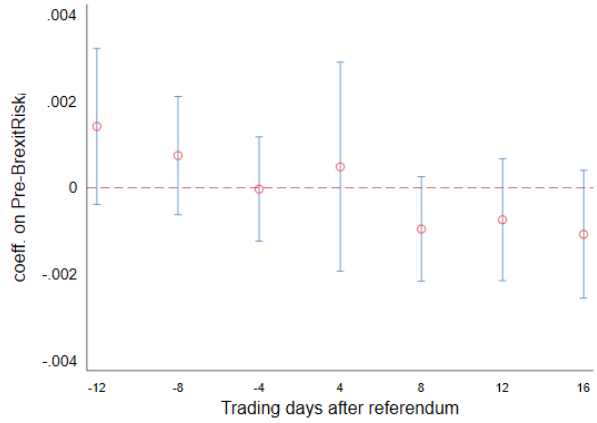
Appendix Figure 1: Placebo Tests



Rejection rate (< -1.96): 3.62%

The figure plots the distribution of t-statistics from the regression specifications in Table 6 Column 5 for repeated regressions taking 4 consecutive trading days at a time from January 1, 2012 - December 31, 2015, for the coefficient on Pre-BrexitRisk$_i$.

Appendix Figure 2: Alternative Event Windows - 2014 (Placebo year)



The figure above show 95% confidence intervals on the coefficient of Pre-Brexit Risk$_i$ for 3 consecutive event windows around the referendum in same calendar days as Figure 5 for year 2014 for the specification in Table 6 Column 5. Each event window consists of 4 consecutive trading days.

Appendix Table 4: Brexit Risk by country

Country	Mean	Max	N
Ireland	1.681	18.312	53
UK Channel Islands	1.174	10.564	8
United Kingdom	1.000	18.911	396
South Africa	0.579	7.926	74
Netherlands	0.444	5.560	76
Denmark	0.434	5.299	50
France	0.386	4.617	130
Belgium	0.372	5.054	31
Switzerland	0.326	7.673	98
Sweden	0.322	12.592	147
Singapore	0.314	5.565	41
Germany	0.304	3.658	150
Spain	0.287	3.696	61
Australia	0.208	9.910	321
Norway	0.205	7.506	68
Monaco	0.202	2.021	10
Hong Kong	0.189	4.437	77
Austria	0.152	2.523	31
S. Korea	0.151	1.658	34
Bermuda	0.131	2.291	63
Canada	0.125	6.469	546
India	0.118	5.104	270
Finland	0.116	4.245	45
Japan	0.115	4.382	153
Luxembourg	0.114	1.713	34
USA	0.111	18.371	3,791
Italy	0.096	3.494	75
Mexico	0.084	4.151	68
Turkey	0.061	0.808	23
Russia	0.055	2.238	41
Malaysia	0.030	0.548	18
New Zealand	0.030	1.183	39
Chile	0.027	0.681	25
Greece	0.025	0.498	20
Poland	0.023	0.644	28
Israel	0.022	1.353	61
China	0.005	0.870	181
Brazil	0.004	0.561	139

Countries included have at least 5 sample firms headquartered in that country and non-zero Brexit Risk. Zero Brexit Risk countries: Puerto Rico, Thailand, Cayman Islands, Portugal, Indonesia, Cyprus, Nigeria, Czech Republic, United Arab Emirates, Argentina, Peru, Phillipines, Columbia. Country level values are calculated by taking the average over all firms headquartered in a respective country. N is the total number of firms in our sample in the country.

Appendix Table 5: Brexit Sentiment by country

Country	Mean	Min	Max	*N*
Ireland	-1.386	-44.593	8.898	53
United Kingdom	-1.000	-37.778	10.806	396
Germany	-0.773	-17.177	8.064	150
Austria	-0.604	-12.918	2.507	31
Norway	-0.561	-14.526	1.670	68
Italy	-0.544	-18.209	3.872	75
Denmark	-0.494	-9.236	5.241	50
Sweden	-0.441	-33.137	12.056	147
France	-0.404	-22.672	9.341	130
Hong Kong	-0.403	-14.837	5.014	77
New Zealand	-0.392	-9.267	0.000	39
Singapore	-0.376	-6.424	0.887	41
Monaco	-0.338	-3.379	0.000	10
Belgium	-0.321	-3.250	1.352	31
Chile	-0.308	-6.565	0.000	25
Greece	-0.285	-3.712	0.000	20
Luxembourg	-0.271	-3.461	0.000	34
Malaysia	-0.258	-4.649	0.000	18
Spain	-0.241	-6.095	2.173	61
USA	-0.223	-35.008	20.364	3,791
India	-0.210	-12.173	15.205	270
Turkey	-0.208	-2.433	0.000	23
Russia	-0.182	-7.481	0.000	41
Finland	-0.166	-4.368	3.816	45
Mexico	-0.150	-5.373	1.084	68
Canada	-0.140	-13.691	9.301	546
Japan	-0.131	-25.473	10.767	153
South Africa	-0.130	-4.569	11.808	74
Switzerland	-0.128	-6.600	6.718	98
S. Korea	-0.089	-3.369	1.386	34
Netherlands	-0.068	-6.199	10.260	76
China	-0.060	-7.817	0.000	181
Bermuda	-0.043	-4.750	4.579	63
Brazil	-0.032	-2.449	1.013	139
Israel	0.023	0.000	1.388	61
Poland	0.057	0.000	1.607	28
Australia	0.062	-16.335	38.573	321
UK Channel Islands	1.713	-2.341	15.728	8

Countries included have at least 5 sample firms headquartered in that country and non-zero Brexit Risk. Zero Brexit Risk countries: Puerto Rico, Thailand, Cayman Islands, Portugal, Indonesia, Cyprus, Nigeria, Czech Republic, United Arab Emirates, Argentina, Peru, Phillipines, Columbia. Country level values are calculated by taking the average over all firms headquartered in a respective country. N is the total number of firms in our sample in the country.

Appendix Table 6: Brexit Risk and Sentiment, and Other Firm Outcomes

Panel A	$\Delta emp_{i,t}/emp_{i,t-1} \cdot 100$					
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{BrexitRisk}_{i,t}$	–0.487***	–0.689**	–0.495***	–0.391**	–0.589**	–0.840***
	(0.176)	(0.272)	(0.179)	(0.179)	(0.289)	(0.308)
$\text{BrexitSentiment}_{i,t}$	0.000	–0.009	–0.016	–0.011	–0.038	0.010
	(0.083)	(0.084)	(0.084)	(0.082)	(0.108)	(0.108)
$\text{BrexitRisk}_{i,t} \times \mathbb{1}\{\text{UK HQ}\}$		0.584**				
		(0.287)				
$\text{Non-BrexitRisk}_{i,t}$			–0.004	–0.018***	–0.035***	–0.035***
			(0.004)	(0.005)	(0.008)	(0.008)
$\text{Non-BrexitSentiment}_{i,t}$			0.003***	0.003***	0.003***	0.003***
			(0.000)	(0.000)	(0.001)	(0.001)
Average UK sales_i (pre-Brexit)					–2.756	–4.246
					(3.198)	(3.327)
$\overline{\text{BrexitExposure}_i}$						2.413**
						(1.137)
R^2	0.020	0.021	0.024	0.052	0.064	0.065
N	27,156	27,156	27,156	27,141	18,326	18,326

Panel B	$log(TFPR_{i,t})$					
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{BrexitRisk}_{i,t}$	–0.132***	–0.136***	–0.136***	–0.123***	–0.106**	–0.093*
	(0.045)	(0.051)	(0.044)	(0.042)	(0.052)	(0.052)
$\text{BrexitSentiment}_{i,t}$	–0.015	–0.017	–0.016	–0.013	–0.006	–0.010
	(0.013)	(0.013)	(0.013)	(0.013)	(0.016)	(0.015)
$\text{BrexitRisk}_{i,t} \times \mathbb{1}\{\text{UK HQ}\}$		0.072				
		(0.076)				
$\text{Non-BrexitRisk}_{i,t}$			0.002***	0.001	0.002	0.002
			(0.001)	(0.001)	(0.002)	(0.002)
$\text{Non-BrexitSentiment}_{i,t}$			0.000**	0.000**	0.000*	0.000*
			(0.000)	(0.000)	(0.000)	(0.000)
Average UK sales_i(pre-Brexit)					–0.934	–0.881
					(0.598)	(0.602)
$\overline{\text{BrexitExposure}_i}$						–0.203
						(0.407)
R^2	0.524	0.525	0.526	0.540	0.566	0.566
N	6,434	6,434	6,434	6,433	4,858	4,858
Year FE	Y	Y	Y	Y	Y	Y
SIC FE	Y	Y	Y	Y	Y	Y
SIC - Year FE	N	N	N	N	Y	Y
Country FE	N	N	N	N	Y	Y

This table reports results from sensitivity regressions of $\Delta emp_{i,t}/emp_{i,t-1} \cdot 100$ (panel A), $log(TFPR_{i,t})$ (panel B), and $\Delta sales_{i,t}/sales_{i,t-1} \cdot 100$ (panel C) on $\text{BrexitRisk}_{i,t}$ and $\text{Brexit Sentiment}_{i,t}$ using yearly data. The regressions exclude non-UK firms with less than 10 transcripts in 2015-2018, and firms in Non Classifiable sectors. $\text{BrexitRisk}_{i,t}$ and $\text{Brexit Sentiment}_{i,t}$ are calculated by taking the yearly average across a firm's quarterly earnings call transcripts held in that year. All specifications control for log(assets) and standard errors are clustered by firm. Specifications control for year, 2-digit SIC, and country fixed effects. Dependent variable is winsorized at the 1st and 99th percentile. The regressions exclude non-UK firms with less than 10 transcripts in 2015-2018, and firms in the 'Non Classifiable' sectors. Note that manufacturing shares from the NBER CES dataset are only available till 2011; therefore, for calculating TFPR we take average share for each industry from 2002-2011.

Appendix Table 7: Brexit Risk and Sentiment, and Other Firm Outcomes

Panel D	$\Delta sales_{i,t}/sales_{i,t-1} \cdot 100$					
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{BrexitRisk}_{i,t}$	–0.377	–0.299	–0.396	–0.135	–0.574	–1.044**
	(0.251)	(0.251)	(0.253)	(0.251)	(0.394)	(0.409)
$\text{BrexitSentiment}_{i,t}$	0.136*	0.179*	0.118	0.135*	0.135	0.224*
	(0.074)	(0.097)	(0.075)	(0.081)	(0.129)	(0.128)
$\text{BrexitSentiment}_{i,t} \times \mathbb{1}\{\text{UK HQ}\}$		–0.166				
		(0.122)				
$\text{Non-BrexitRisk}_{i,t}$			0.014	–0.000	–0.023	–0.023
			(0.009)	(0.010)	(0.017)	(0.017)
$\text{Non-BrexitSentiment}_{i,t}$			0.004***	0.004***	0.005***	0.005***
			(0.001)	(0.001)	(0.001)	(0.001)
Average UK $\text{sales}_i(pre - Brexit)$					–3.111	–5.805
					(8.740)	(9.379)
$\overline{\text{BrexitExposure}_i}$						4.569**
						(2.093)
R^2	0.024	0.024	0.025	0.052	0.061	0.062
N	29,059	29,059	29,059	29,042	18,967	18,967
Year FE	Y	Y	Y	Y	Y	Y
SIC FE	Y	Y	Y	Y	Y	Y
SIC - Year FE	N	N	N	N	Y	Y
Country FE	N	N	N	N	Y	Y

This table reports results from sensitivity regressions of $\Delta emp_{i,t}/emp_{i,t-1} \cdot 100$ (panel A), $log(TFPR_{i,t})$ (panel B), and $\Delta sales_{i,t}/sales_{i,t-1} \cdot 100$ (panel C) on $\text{BrexitRisk}_{i,t}$ and Brexit $\text{Sentiment}_{i,t}$ using yearly data. The regressions exclude non-UK firms with less than 10 transcripts in 2015-2018, and firms in Non Classifiable sectors. $\text{BrexitRisk}_{i,t}$ and Brexit $\text{Sentiment}_{i,t}$ are calculated by taking the yearly average across a firm's quarterly earnings call transcripts held in that year. All specifications control for log(assets) and standard errors are clustered by firm. Specifications control for year, 2-digit SIC, and country fixed effects. Dependent variable is winsorized at the 1st and 99th percentile. The regressions exclude non-UK firms with less than 10 transcripts in 2015-2018, and firms in the 'Non Classifiable' sectors. Note that manufacturing shares from the NBER CES dataset are only available till 2011; therefore, for calculating TFPR we take average share for each industry from 2002-2011.

Appendix Table 8: Distribution of firms across Counties in UK

Number of counties	Number of firms
54	1
26	2
14	3
7	4
5	5
3	6
3	7
1	8
1	10
1	54
1	90

The table shows the number of counties (left column) with number of firms in our sample headquartered in the county (right column).