TWO SIGMA

Street View

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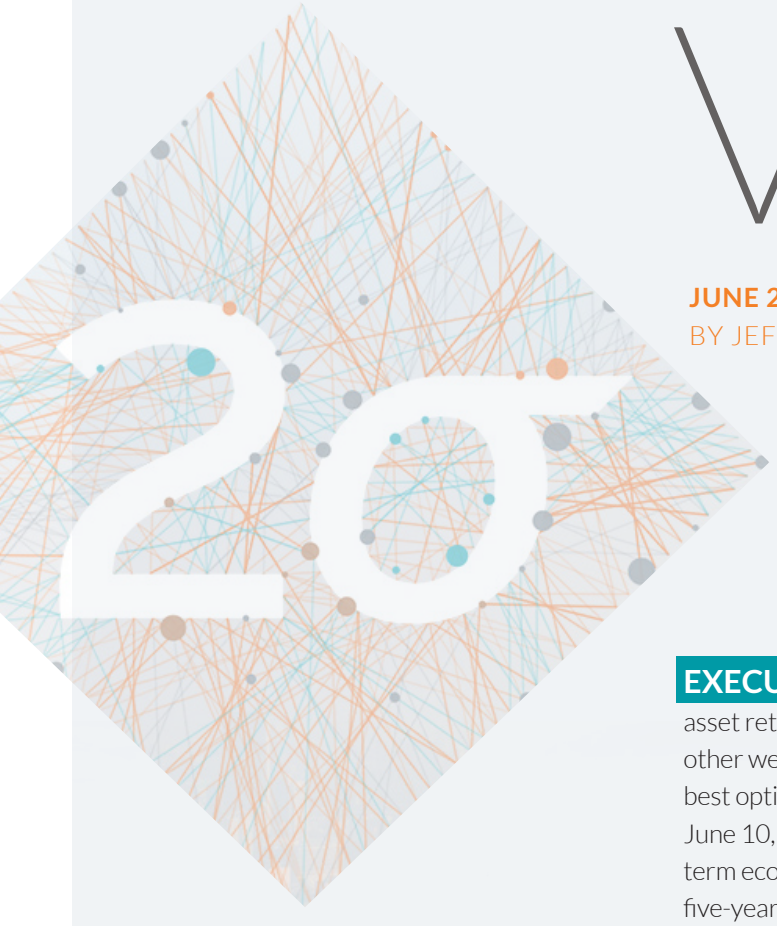
BY JEFFREY N. SARET & GERARDO MANZO



EXECUTIVE SUMMARY Identifying the effect of Brexit risk on asset returns proves challenging due to a lack of data. Translating news and other web stories into data and studying asset volatility may offer a second-best option. An analysis of search-volume from November 2015 through June 10, 2016 shows that Brexit seems to affect assets related to longer-term economic effects, like corporate profitability and default risk (e.g., FTSE, five-year CDS spreads on UK sovereign debt), more than assets tied to monetary policy (e.g., ten-year Gilts and the GBP exchange rates).

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BREXIT RISK AND ASSET VOLATILITY

On Wednesday April 18, 1951, the prince of Belgium, the grand duchess of Luxembourg, the queen of the Netherlands, and the presidents of Germany, France, and Italy signed the treaty establishing the European Coal and Steel Community, which would become known as the Treaty of Paris. In the wake of World War II, these European countries hoped to create an organized and vital Europe through the establishment of economic ties.

Like marching soldiers, European countries have since steadily trudged towards an ever closer union. A vote by British citizens on June 23 may break that stride, as the United Kingdom decides whether it wants to remain in the European Union.

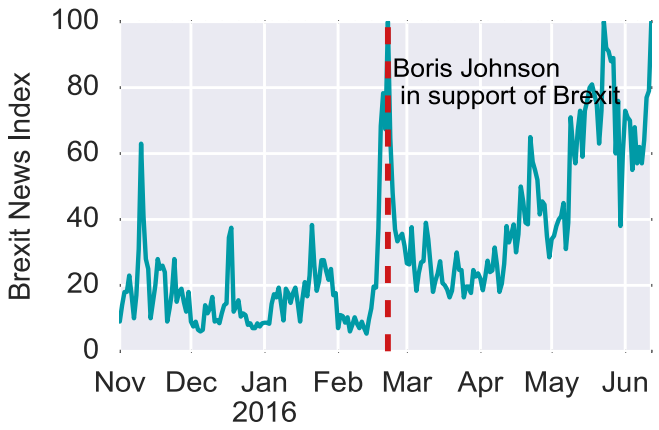
Recognizing the significance of a "Brexit" event appears easy. Identifying its effect on asset returns, on the other hand, proves more difficult. Few relevant historical case studies exist, particularly because the legal and institutional implications for a country to leave the European Union remain unknown (e.g., will the Schengen Area or the common market end? Will other countries follow the UK's example?). In theory, prediction or betting market information joined with other data sets could offer quantitative insights. In practice, these markets suffer from limited depth on the Brexit topic, particularly over the time horizons necessary to derive statistical confidence for an empirical analysis.

In lieu of trying to quantify the effect of Brexit on asset prices, quantifying the effect on asset volatility offers a second-best approach. Research published in academic journals (e.g., Rigobon, 2003) outlines a two-step application. First, measure the news volume for a topic to serve as a proxy for the time-varying risk of that topic. Second, compare the variance of asset prices on high news-volume days (i.e., a "treatment" group) to the variance on other days (i.e., a "control" group). For assets most at risk from an event, the ratio of the variances will not equal one (i.e., the treatment will look different than the control). Rigobon and Sack (2005) apply this methodology to estimate the effect of the 2003 Iraq war on asset markets. Applying this approach to recent website term-searches shows that Brexit has affected assets related to longer-term economic effects like corporate profitability and default risk (e.g., FTSE, five-year CDS spreads on UK sovereign debt) more than assets tied to monetary policy (e.g., ten-year Gilts and the GBP exchange rates).

BREXIT NEWS VOLUME HAS TRENDED HIGHER SINCE MARCH 2016

Google Trends offer a publicly available repository of search-volume. Figure 1 plots an index of the daily quantity of searches of the term "Brexit" from November 2015 through June 10, 2016.[2]

FIGURE 1 BREXIT NEWS-RELATED INDEX



Source: Google Trends and authors' computation.

2 Data collected from Google Trends (http://www.google.com/trends/). Since Google only makes daily data available for sub-samples of three months and normalizes the term-search score by the largest volume in each sub-sample, the values plotted in Figure 1 are based on overlapping three month sub-samples that are then renormalized based on the average value during overlapping days. This process introduces a bit of noise to the index but facilitates longer time horizons.

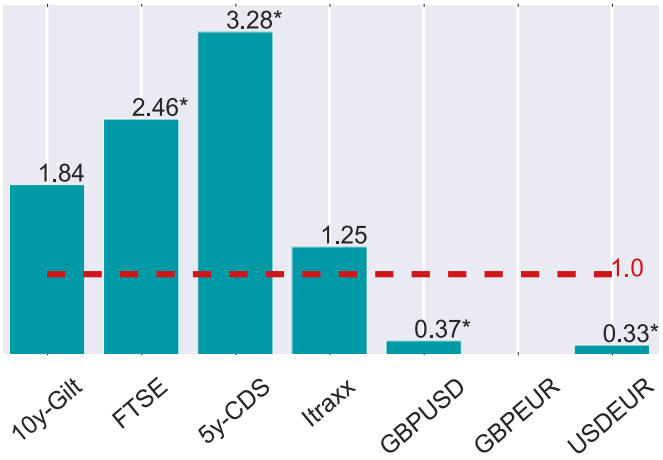
The chart highlights two main points. First, Brexit-volume has mostly trended higher since March 2016, suggesting that Brexit has attracted increasing attention over the past few months. Compare that to the results from the January Two Sigma Macro Tail Risk Survey, when Brexit did not crack the top five tail risks in a survey of sell-side sales professionals.[3] At the time, the survey suggested a "China Hard Landing" or a "Market Liquidity Event" presented greater risk.

Second, the volume of searches fluctuates widely on a daily basis, which makes statistical analysis both easier (more variation) and trickier (more noise). Since most searches utilize a relatively static structure (e.g., a preset number of newspaper pages or a predefined television program length), the volume of Brexit-related searches will typically vary due to two factors: an event that changes the probability of a stay or leave vote, and the relative importance of Brexit on a day when other news events occur (e.g., terrorist attacks, changes in the oil price). For example, On February 22, 2016, London mayor Boris Johnson publicly declared his support for Brexit, and the volume of Brexit stories spiked. Conversely, on May 19, 2016, the crash of an EgyptAir flight captured more attention.

BREXIT INCREASES VOLATILITY IN UK-RELATED EQUITY AND CREDIT MARKETS

Since November 2015, Brexit risk appears to have affected UK-listed stocks and credit markets more than other assets. On days when changes in Brexit-volume was two standard deviations above the mean, the variance of UK-listed equities (proxied by the FTSE) was nearly 2.5 times greater than on other days. Similarly, the variance on the credit default swaps (CDS) of the UK government was more than three times greater than other days. Brexit-searches had no statistically significant effect on UK 10 year sovereign debt or European CDS spreads (iTraxx). These results appear consistent with the belief that Brexit would adversely affect the long-term real economy by harming corporate profitability, reducing both earnings and the ability of financial institutions to manage their debt.

FIGURE 2 RATIOS OF VARIANCES ON BREXIT-RELATED AND NON-BREXIT-RELATED DAYS FOR SELECTED ASSET CLASSES



Notes: Asterisk denotes significance at the 10 per cent level.
Source: Bloomberg data and authors' computation, as of June 10, 2016.

Conversely, the variance on the pound was lower on days with relatively abundant Brexit-searches. One potential explanation is that if Brexit occurs, the Bank of England would adjust monetary policy to try to stabilize the broader economy. Since monetary policy has a more direct effect on exchange rates than on equities or credit, Brexit might pose less of a risk in the forex markets than elsewhere. An alternative explanation is that global macroeconomic conditions, such as changes in the oil price, have a relatively larger effect on exchange rates than on UK domestic equity and credit markets. Since Brexit-search volume as a percentage of overall searches was lower on days of global macreconomic uncertainty, a muted effect on the pound seems plausible. This second explanation also appears consistent with the data showing non-GBP currencies (e.g., USDEUR) had significantly lower variance on high Brexit news days.

IMPLICATIONS

When presidents of republics, queens, and princes made real the European dream of a greater and peaceful unification, they probably did not imagine that one day their successors might turn that unity into a collective march towards economic instability. A British exit from the European Union would likely have broader implications beyond UK asset returns. A similar analysis to figure 2 (not reported) shows that Brexit risk already infects

3 See http://www.twosigma.com/uploads/StreetView_Feb_2016_Public.pdf

other European equity markets, particularly Greece and Portugal.

A Brexit might also only prove the first chink in the European armor. The precedent could set in motion a ripple effect that would delink other European countries from the community, affecting the lives not just of the 60 million British citizens but the hundreds of millions of other European Union residents. A recent survey by Ipsos Global reports that an increasing percentage of Europeans, including majorities in France and Italy, would vote to leave the European Union if an exit referendum were held in their countries today.[4] At least the British, and potentially others, will learn to enjoy their tea knowing they have sovereignty over the shillings they use to pay for it.

4 https://www.ipsos-mori.com/researchpublications/researcharchive/3731/Half-of-people-in-nine-European-countries-believe-UK-will-vote-to-leave-the-EU.aspx

References

Rigobon, Roberto. "Identification through heteroskedasticity." *Review of Economics and Statistics* 85.4 (2003): 777-792.

Rigobon, Roberto, and Brian Sack. "The effects of war risk on US financial markets." *Journal of Banking & Finance* 29.7 (2005): 1769-1789.

INTERESTING TECHNOLOGY-RELATED ARTICLES

Two Sigma views itself as a technology company that applies a rigorous, scientific method-based approach to investment management. Our technology is inspired by a diverse set of fields including artificial intelligence and distributed computing. Occasionally, we read articles in the popular press that describe applications of technology that we find interesting, thought-provoking, and relevant for people thinking about improving the investment management process. Below is a subset of the articles we read this month. Please do not view the inclusion of these articles as an endorsement by Two Sigma of their viewpoints or the companies discussed therein. Two Sigma welcomes discussions (and contributions) about these and other such technology-related articles.

"Tesla Knows When a Crash is Your Fault, and Other Carmakers Soon Will, Too" by Tim Simonite June 8, 2016 (https://www.technologyreview.com/s/601657/tesla-knows-when-a-crash-is-your-fault-and-other-carmakers-soon-will-too/#/set/id/601652/)

> With the arrival of semi-autonomous cars, a few drivers have attempted to blame technology for their own poor driving skills. But one of these drivers failed to consider Tesla's constant recording of detailed vehicular data. After a man complained that his wife's new Model X SUV suddenly accelerated into a shopping center, Tesla replied back with a record of what actually happened. The car, in full manual mode, did accelerate—but only in response to the abrupt increase in the accelerator pedal pressure. While Tesla may be only one of a few car companies logging and collecting such comprehensive vehicle data, the industry may soon catch up as internet connectivity in cars increases. Data logging may even help make roads safer. Multiple studies have shown that crash rates decrease after even crude "black boxes" are added to cars.

"Microsoft Finds Cancer Clues in Search Queries" by John Markoff June 7, 2016 (http://www.nytimes.com/2016/06/08/technology/online-searches-can-identify-cancer-victims-study-finds.html?smprod=nytcore-iphone&smid=nytcore-iphone-share&_r=0)

> You may soon be able to add another health diagnostic tool to your arsenal: web searches. From a large sample of Bing search queries, Microsoft scientists developed a method to identify early warning signs of a subsequent pancreatic cancer diagnosis. Their study, published in the Journal of Oncology Practice, suggests that this warning could double the five-year survival rate of pancreatic cancer patients to around 6 percent. While the detection rate was only between 5 to 15 percent of all pancreatic patients, the false positive rate was a very low 0.001%. One of the scientists now heads a new Microsoft division that will work to make symptom alert data available as part of an online health service.

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